

Education/Training

INFORMATION FOR DESIGNERS OF INSTRUCTIONAL SYSTEMS

INTERACTIVE COURSEWARE (ICW) DESIGN, DEVELOPMENT,
AND MANAGEMENT GUIDE

This volume provides information and guidance for applying current instructional technology and the Instructional System Development (ISD) process described in AFMAN 36-2234. This volume is not a directive. It is a guide for deciding when to use ICW to deliver instruction and it also provides guidelines for personnel who are designing and developing ICW. The use of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

Table of Contents

	Page
1. GENERAL INFORMATION.....	4
Overview	4
A. ICW as an Instructional Delivery System	6
B. Quality Improvement in the ICW Process	11
2. WHEN TO USE ICW	13
Overview	13
A. ICW Feasibility	14
B. ICW Format Decisions: Analog and Digital.....	18
C. ICW Authoring Software Decisions	20
D. ICW Hardware Configuration Decisions	32
E. Management and Organizational Support Decisions	40
F. ICW Cost Considerations.....	47
3. HOW TO PLAN AN IN-HOUSE ICW EFFORT.....	54
Overview	54
A. Outline the ICW Effort	55
B. Prepare the Project Team	58
C. Develop Quality Control Procedures	59

	Page
4. HOW TO DESIGN ICW	66
Overview	66
A. Develop the ICW Specification	67
B. Determine Instructional Strategies	70
C. Determine CMI and Testing Strategies	84
D. Develop Flowcharts and Storyboards	87
5. HOW TO DEVELOP ICW	121
Overview	121
A. Program the Lessons	122
B. Produce Visual Displays and Record Audio	125
C. Develop Text, Graphics and Animation	127
D. Develop Supporting Materials and Produce to DoD ICW Requirements	129
Attachment A - Air Force ISD Documents	132
Attachment B - Bibliography	133
Attachment C - Abbreviations	140

List of Tables

	Page
Table 1. General Rules for Using ICW as an Instructional Delivery System	7
Table 2. ICW Feasibility Summary	14
Table 3. Advantages and Disadvantages of Analog and Digital Formats	19
Table 4. Authoring Software Characteristics	22
Table 5. Software Package Information Requirements	30
Table 6. Hardware Configuration Characteristics	34
Table 7. Processing Type Characteristics	35
Table 8. Central Computer Characteristics	36
Table 9. ICW Development Team	41
Table 10. ICW Implementation Team	42
Table 11. Estimated Hours of Development for One Hour of ICW	48
Table 12. Variables Affecting Time Estimates for ICW	50
Table 13. Configuration Control Decision Matrix	52
Table 14. ICW Phases and Steps	56
Table 15. Sample Format for ICW Review and Approval	60
Table 16. QC Responsibilities of ICW Development Team	61
Table 17. Sample Format for Subject Matter Expert (SME) Design Review	62
Table 18. Sample Format for Quality Specialist Final Lesson Review	63
Table 19. Sample Format for Discrepancy Report	65
Table 20. Events of Instruction for ICW	71
Table 21. ICW Content Types	72
Table 22. Level of Processing for Content Type	72
Table 23. Guidelines for Increasing Interactivity	74
Table 24. Guidelines for Designing Learner Control into ICW	76
Table 25. Guidelines for Designing Feedback for ICW	79

	Page
Table 26. Guidelines for Designing ICW Tests.....	85
Table 27. Steps Involved in Storyboard Development.....	90
Table 28. Guidelines for Storyboarding ICW	91
Table 29. Guidelines for Visual Elements of Storyboard.....	94
Table 30. Guidelines for Video Elements of Storyboard.....	98
Table 31. Guidelines for Text Elements of Storyboard.....	101
Table 32. Guidelines for Graphics and Animation Elements of Storyboard.....	102
Table 33. Guidelines for Audio	103
Table 34. Programming Standards Considerations.....	106
Table 35. Guidelines for Programming Elements of Storyboard	108
Table 36. Storyboard Checklist.....	109
Table 37. Programming Guidelines During Development Phase of ICW	122
Table 38. Guidelines for Producing Video	125
Table 39. Guidelines for Producing Audio.....	126
Table 40. Guidelines for Displays in ICW Program.....	127
Table 41. Guidelines for Producing to DoD ICW Requirements.....	129

List of Decision Aids

	Page
Decision Aid 1. ICW Feasibility Determination.....	16
Decision Aid 2. Exportable ICW Feasibility	17
Decision Aid 3. Selection and Tradeoff Analysis of Authoring Software Capabilities	24
Decision Aid 4. Selection of Configuration Type.....	33
Decision Aid 5. Selection of Processing Type for Networking.....	34
Decision Aid 6. Selection of Central Computer Type for Networking.....	35
Decision Aid 7. Selection of Input and Output Devices for Development of Delivery Stations	37
Decision Aid 8. Hardware Tradeoff Analysis Data Collection.....	38
Decision Aid 9. Evaluation of Organizational Support for ICW	43
Decision Aid 10. Modification of Support Level.....	44
Decision Aid 11. Organizational Support Reevaluation	45
Decision Aid 12. Contractor Support Determination.....	45

List of Figures

	Page
Figure 1. Sample ICW Course Organization	68
Figure 2. Example of ICW Flowchart (Subject: Bearing Identification).....	88

Chapter 1

GENERAL INFORMATION

Overview

Introduction

This pamphlet provides background information and guidance for deciding when to use computer-based training technology to develop interactive instruction. It also provides guidelines and decision aids for Air Force personnel who are designing and developing Interactive Courseware (ICW).

**Introduction to
ICW**

This chapter describes ICW as an instructional delivery system and presents general information on how to improve the quality of Air Force ICW.

**Where To Read
About It**

This chapter contains two sections.

Section	Title	See Page
A	ICW as an Instructional Delivery System	6
B	Quality Improvement in the ICW Process	11

**Additional
Information**

Additional information pertinent to the acquisition and development of ICW can be found in the following documents:

- DODI 1322.20, Development and Management of Interactive Courseware for Military Training, 14 March 1991.

This instruction establishes DOD policy and guidelines for producing and managing ICW. Specific requirements can be found in this handbook on page 129, Table 41.

- MIL-STD-1379D, Military Training Programs, 5 December 1990.

This document provides tailorable requirements and task descriptions for acquisition of military training programs. By utilizing these standardized task descriptions when contracting for training services, your contract will more precisely state your requirements and contractor pricing will be more accurate. The use of these standard task descriptions also facilitates Continuous Acquisition Lifecycle Support (CALS) initiatives. In addition, Appendix D of 1379D provides a standard set of commands to be used by courseware and authoring systems for communicating with computer hardware. These standards ensure that ICW and authoring systems developed in accordance with 1379D will be portable across computer systems (up to interactive videodisc) that

**Additional
Information
(Continued)**

follow 1379D hardware and operating system requirements. Please note that these standards address software portability only and not device interoperability. This means that you can move ICW between different manufacturers' machines and be assured that it will work; however, it is not guaranteed that your laser disc player will work as you move it between different manufacturers' machines.

- MIL-HDBK-284, Parts 1-3, Interactive Courseware for Military Training, 22 July 1992.

This handbook provides guidance on ICW analysis, design, development, implementation, and logistics and life support and is applicable to ICW that is contracted for or developed. The handbook is divided into three parts. Part 1 provides information for acquisition, program, contract, logistics support, and training program managers on the development and contract of ICW for military training. Additional guidance on the application, tailoring and acceptance of MIL-STD-1379D task descriptions and deliverable data is also provided. Part 2 is used with MIL-STD-1379D and Part 1 to establish and implement standard ICW portability protocols. Part 3 is a glossary that provides definitions for key terms, abbreviations, and acronyms used in MIL-HDBK-284 as well as other terms related to military training and ICW.

- AFI 36-2201, Developing, Managing, and Conducting Military Training.

This instruction outlines the requirements for ICW development (both contractor- and in-house-developed) as stated in DODI 1322.20.

Section A

ICW as an Instructional Delivery System

What Is ICW?	ICW is a type of computer-controlled training where the learning experience is based on the interaction between the learner and the computer system. The student's decisions and inputs to the computer determine the level, order, and pace of instructional delivery, and forms of visual and aural outputs.
How ICW Works	With an interactive program, the student advances through the sequence of instructional events by making decisions and selections through an input device such as a keyboard, touch screen, mouse, trackball, light pen, or joystick. The instruction branches according to the student's inputs and responses.
ICW and the ISD Process	The Instructional System Development (ISD) process provides the framework for developing Air Force training (see AFMAN 36-2234). Within the framework of the ISD process, training requirements are established and translated into appropriate instructional objectives. In the design phase, one of the first and most important tasks is that of selecting the instructional delivery system .
Examples of Instructional Delivery Systems	ICW, platform instruction, formal on-the-job training, and training devices and simulators are examples of instructional delivery systems. Time spent in properly matching training needs to the most appropriate delivery system will ensure that today's selected state-of-the-art technologies do not become tomorrow's dust collectors.
Advantages of ICW	ICW, with characteristics never before available at any price, may be a suitable instructional delivery system for many training objectives. Thanks to the rapid development of computer technology, it is now possible to create, at a reasonable price, new ways of designing and developing education and training materials. Today, computers can be used to deliver interactive, competency-based, individualized, multimedia instruction.
General Rules for Selecting ICW as an Instructional Delivery System	Brandt (1987) proposed certain rules for using interactive video as a training delivery system. Brandt's rules have been revised to apply to any form of ICW in an Air Force setting. The rules are shown in Table 1.

Table 1. General Rules for Using ICW as an Instructional Delivery System

Rule 1	Use ICW to gather a large collection of multimedia material, such as slide collections or still photographs or a mixture of still-frame and motion sequences on film or video.	Rationale: When the volume of slides and the demand for reproduction reach a certain point, the use of interactive videodisc (IVD) or CD-ROM may prove to be the most cost-effective means of distribution. As for motion sequences, film and video reproduction is, in the long run, much more expensive than videodisc or CD-ROM reproduction. Also, film and video tapes tend to deteriorate over time, where IVD or CD-ROM will maintain the images at the same resolution for extensive periods.
Rule 2	ICW training should be considered when there are a large number of learners distributed over time and place.	Rationale: In this instance, a cost tradeoff exists between self-paced, individualized training and lecture-based training. The break-point is achieved when the number of students is so large that it becomes more economical to use individualized training methods rather than lecture.
Rule 3	ICW may be applied when instructors with subject matter expertise are in short supply.	Rationale: Reductions in force, base closings, incentives for early-outs, introduction of advanced technology weapon systems, and instructors who are subject matter experts (SME) but not skilled educators are some of the reasons it is advantageous to capture subject matter expertise into an ICW program.

Continued

**Table 1. General Rules for Using ICW as an Instructional Delivery System
(Continued)**

Rule 4	Consider using ICW applications when it is necessary to allow students to practice a skill and a simulator or real equipment is impractical or unavailable for this training.	Rationale: Use of real equipment or a simulator for training may present a number of needs that could be met with an ICW simulation. If designed correctly, an ICW simulation can often greatly reduce the amount of time required in hands-on training on real equipment or a simulator. Real equipment or a simulator might not be available to provide every student with an opportunity to practice. Real equipment may be undesirable for hands-on training because it is too delicate for constant use.
Rule 5	ICW can provide a safe, yet realistic, simulation of dangerous activities and situations.	Rationale: When potentially hazardous procedures must be demonstrated or practiced, simulation often becomes a necessity. A case in point involves teaching maintenance personnel how to repair high-voltage equipment. It is not possible to practice this task in an actual situation. Simulation would allow maintenance personnel to practice proper procedures without exposure to actual dangers. An ICW simulation can show the effects of improperly performed procedures without damaging equipment or injuring personnel.

Continued

**Table 1. General Rules for Using ICW as an Instructional Delivery System
(Continued)**

Rule 6	ICW is a particularly suitable delivery system when training requires continuous practice and/or retraining.	Rationale: One of the most desirable features of ICW is the ease with which any portion of a course or lesson can be retrieved and reviewed. This characteristic of ICW is best illustrated by pilot training. Continuous practice is required in training because pilots must demonstrate near-perfect proficiency in simulated flight situations before they are permitted to operate an aircraft.
Rule 7	ICW can be a very useful delivery method in training problem-solving and decision- making skills.	Rationale: Since advanced or higher-order skills are usually learned "on the job," experienced workers are often forced to spend valuable time training unskilled workers, at the expense of their own jobs. ICW training could be substituted, thereby freeing skilled employees from the task of training others. In theory, this type of formal training has the potential to increase the productivity of all employees, and thus save the organization considerable expense.
Rule 8	When a training situation is such that students vary in experience, learning style, and skill level, ICW instruction can provide different types and levels of instruction to different students.	Rationale: Specific features can be designed into an ICW program to allow users to advance from level to level based on their experience and skill levels. ICW programs can be designed to facilitate individual differences in students' learning styles. For example, if the learners are visually oriented rather than spatially oriented, the ICW might contain useful motion video and animation extensively.

**Key to Using
ICW**

Deciding when to use ICW requires a step-by-step examination process. ICW should **not** be selected simply for its technological appeal. ICW is **not** the best method for every training objective in the Air Force. This pamphlet provides background information and decision aids to help you decide when ICW is an appropriate instructional method.

Section B

Quality Improvement in the ICW Process

Definition	Quality improvement is the continuous, organized creation of beneficial change to the process of designing and developing ICW. The objective of quality improvement is to foster continuous improvement in the ICW process and products.
Continuous Improvement	Continuous improvement of the quality of Air Force instructional programs is an ongoing concern. Each phase of the ISD process is designed to force managers and designers to ask the right questions to help focus on the actual needs of the customer in terms of requirements, schedules, and budgets. Customer satisfaction is the number one goal, and customer satisfaction translates into meeting instructional requirements in the most effective and efficient manner possible.
Define Customer's Needs	The first and most important step in developing quality ICW is to define the customer's needs and requirements. See AFH 36-2235, Volume 6, for details on how to conduct a training needs assessment in the Air Force. It is impossible to design an adequate training program without knowing the lack of knowledge or the performance problems that need to be solved. The problems, needs, requirements and objectives of the instructional program must be fully defined and agreed upon before proceeding with the detailed instructional design.
Keep Customer Involved	Once the requirements for the program have been established and agreed upon, it is important to keep the customer involved in the process. There are several natural phase points in the development of an ICW program where the customer should be involved in the development and review of different products that make up the ICW material. This pamphlet addresses when to involve customers in the ICW development process.
Get "Buy In"	It is essential that your customer "buy in" to your process and design. If your customer disagrees with your solutions or ideas, it is better to find out and make adjustments early in the process. If you keep your customer involved throughout the process, there should be no "surprises" when the final product is delivered.
Establish ICW Team	Many different people are involved in the ICW process. Each member of the ICW development team must know what is expected of them. Not only do they need to know what products are required and when, they need to know how ICW programs in your organization look and function. This pamphlet discusses team membership and responsibilities.

**Use These
Guidelines**

The guidelines in this pamphlet will help you design and develop quality ICW. The guidelines are drawn from the experience of many ICW development teams throughout the Air Force and DoD. These guidelines are not meant to be binding on all ICW programs. They should be evaluated for use in your environment, and adjusted accordingly. The guidelines are a starting point to developing your own style guide and design criteria.

Chapter 2

WHEN TO USE ICW

Overview

Introduction

Careful planning is essential in any program that brings together a number of resources to accomplish a specific goal. Deciding whether to use ICW requires very careful planning and consideration. This chapter provides information and decision aids to help you decide when to use ICW.

Where To Read About It

This chapter contains six sections.

Section	Title	See Page
A	ICW Feasibility	14
B	ICW Format Decisions: Analog and Digital	18
C	ICW Authoring Software Decisions	20
D	ICW Hardware Configuration Decisions	32
E	Management and Organizational Support Decisions	40
F	ICW Cost Considerations	47

Additional Information

For additional information on how to determine when to use ICW, see:

- Brandt, R. H. (1987). *Videodisc Training: A Cost Analysis*. Falls Church, Virginia: Future Systems, Inc.
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Section A

ICW Feasibility

Introduction The general feasibility of ICW is evaluated by examining the following factors:

- Content factors
 - Student factors
 - Organizational factors
-

ICW Feasibility Summary Table 2 presents a summary of the three ICW feasibility factors and their impact on the decision to use ICW.

Table 2. ICW Feasibility Summary

Rule	A	B	C
	Type of Factor	Data Examined	Impact on ICW Decision
CONTENT			
1	Content characteristics	Training objectives	Consider ICW if training effectiveness is dependent on or enhanced by graphic, sound, motion, or photographic presentation.
2	Content stability	Likelihood of major revisions	Consider ICW if major revisions are limited to one per year.
3	Training time	Projected number of ICW lessons	Consider ICW if the number of projected ICW lessons can offset development and maintenance costs within 2 years.
4	Course life cycle	Projected course life	Consider ICW if development and maintenance costs can be offset during the life of the course.
STUDENT			
5	Learning style	Former student records	Consider ICW if learning style is highly visual. (Resulting ICW should also be visually oriented with heavy use of video graphics.)
6	Reading ability	Former student records	Consider ICW only if reading ability supports projected reading level of anticipated lessons.
7	Motivation level	Former student records	Consider highly interactive ICW with frequent embedded questions/extensive feedback if low motivation is expected.

Continued

Table 2. ICW Feasibility Summary (Continued)

Rule	A	B	C
	Type of Factor	Data Examined	Impact on ICW Decision
ORGANIZATIONAL			
8	Training equipment	Availability for hands-on training	Consider ICW with simulation capabilities if hands-on equipment is unavailable.
9	Staff availability	Resources and commitments	Consider ICW if staff is available for dedicated assignment to ICW project.
10	Staff experience	Resumes	Consider ICW regardless of staff experience. Plan for learning curve time if staff is inexperienced.
11	Attitude toward ICW	Staff meetings	Consider ICW if resistance is moderate or low. Plan for ICW awareness training if resistance is high.
12	Support for ICW	Management meetings	Consider ICW if support is evident. Plan for development of position paper if support is low.
13	Development schedule	Management meetings	Given a short schedule, consider ICW if staff experience is extensive, instructor resistance is low, and management support is high.

**Decision Aid 1:
ICW Feasibility
Determination**

Decision Aid 1, ICW Feasibility Determination, will help you evaluate the feasibility of using ICW.

**How To Use
Decision Aid 1**

The ICW feasibility determination decision aid lists the factors that impact the ICW decision. The factors are in the form of yes/no questions.

Consider pursuing ICW if you obtain five or more "yes" responses from the factors on the decision aid.

The three factors with an asterisk (*) are especially critical because they influence ICW costs. A "no" response to any of these three questions provides evidence that ICW should not be pursued.

The factor with the double asterisk (**) is also critical. A "yes" response to this question strongly indicates a need for ICW.

Decision Aid 1. ICW Feasibility Determination

Type of Factor		Feasibility Question	Yes	No
C O N T E N T	Content characteristics	Is ICW training effectiveness dependent on or enhanced by graphic, motion, sound, or photographic presentation?		
	Content stability*	Are ICW major revisions limited to one per year?		
	Training time*	Can the number of projected ICW lessons offset development and maintenance costs within 2 years?		
	Course life cycle*	Is course life expectancy long enough to offset a reasonable portion of development or maintenance costs?		
S T U D E N T	Learning style	Is learning style highly visual?		
	Reading ability	Does reading ability support projected reading level of anticipated lessons?		
	Motivation level	Is low motivation expected?		

O R G A N I Z A T I O N A L	Training equipment**	Is hands-on equipment unavailable for training?		
	Staff availability	Is staff available for dedicated assignment to ICW?		
	Staff experience	Is staff experienced?		
	Attitude toward ICW	Is acceptance to ICW high?		
	Support for ICW	Is support for ICW evident?		
	Development schedule	Is the schedule flexible?		

* A "no" response to this factor's question may indicate strong evidence that ICW should not be pursued unless ICW will be developed in an all-digital format.

** A "yes" response to this factor's question indicates a need for ICW.

**ICW
Exportability
Issue**

Exportable ICW is ICW which is developed and/or managed at a centralized location, but delivered at more than one remote user facility.

**Decision Aid 2:
Exportable ICW
Feasibility**

If you plan to export ICW to remote locations, use Decision Aid 2, Exportable ICW Feasibility, to determine if it is possible to do so.

**How To Use
Decision Aid 2**

The exportability decision aid has three parts. Here is a description of each part.

PART	DESCRIPTION
I	If you obtain a "yes" response to all three questions in Part I, go directly to Part III. If you obtain a "no" response to any of the questions in Part I, you need to complete Part II.
II	A "no" response to either question in Part II indicates that exportable ICW cannot be supported by the field unit budget and should not be attempted until funds are allocated. "Yes" responses to Part II indicate that exportable ICW is feasible, and you should complete Part III.
III	"Yes" responses to the questions in Part III indicate that ICW is feasible.

Decision Aid 2. Exportable ICW Feasibility

Exportability Questions	Yes	No
PART I		
Is there existing hardware at the field unit that can support ICW training?		
Is the number of hardware stations sufficient to train the number of ICW students?		
Is the existing hardware available for ICW training?		
PART II		
Is budget available for hardware and software procurement?		
Is budget available for operating ICW?		
PART III		
Is ICW an appropriate media for presenting this content?		
Is the number of projected lessons large enough to justify ICW use?		
Is the number of projected students large enough to justify ICW use?		

Section B

ICW Format Decisions: Analog and Digital

Introduction

This section describes two formats for ICW: analog and digital.

Definition of Formats

Here are the definitions of the two formats for ICW.

Format	Definition
Analog	Data that is represented by infinite variance in some physical quantity such as voltage or current. Videodiscs store video in analog format.
Digital	Data that is represented by a pattern of discrete, fixed values. This information is stored as a series of "1's" and "0's". CD-ROMs store data in a digital format.

Combination of Formats

Many ICW programs combine the two formats by storing analog video and digital audio on a videodisc and digital text and graphics on the computer hard disk.

Use of Video

Analog video can be stored on a videodisc. Digital video can be stored on a hard disk or CD-ROM.

Advantages and Disadvantages of IVD and Digital Formats

Consider developing ICW in an all-digital format if no hardware (such as laserdisc players), no software (such as Quest or WISE), or no courseware (such as IVDs) already exist for the training need. Table 3 lists advantages and disadvantages of analog (IVD) and digital formats.

Table 3. Advantages and Disadvantages of Analog and Digital Formats

Format	Advantages	Disadvantages
Analog (IVD)	<ul style="list-style-type: none"> • Requires laserdisc player • Many software packages available • Proven and stable technology 	<ul style="list-style-type: none"> • Difficult to change • Some Level III designs not possible • Limited amount of information per disc side • Often has high production costs

Digital	<ul style="list-style-type: none">• Very flexible (easy to make changes)• Very powerful (good for Level III simulations)• Requires less post-video production, which reduces costs• Allows for fast integration of existing resources• Conducive to rapid prototyping• Can greatly impact distance learning due to digital data networking• Digital standards are rapidly emerging for common software environments (e.g., Windows)• No external player is required	<ul style="list-style-type: none">• Technology still evolving• Can be expensive due to learning curve• Experienced programmers may be needed• Hardware and compression algorithms are changing rapidly
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Section C

ICW Authoring Software Decisions

Introduction	This section describes authoring software and how the characteristics of authoring software affect selection of an authoring software package. Decision aids for selecting authoring software are presented.
What You Need	In order to make a decision regarding ICW authoring software you will need to have experience with programming, courseware development, and instructional design. If you do not have experience in these areas, you need to find personnel who do have experience and get them to help you complete the decision aids and select an authoring software package.
Review Policies and Regulations	The ICW software decision is based on a number of selection factors, military acquisition restrictions, command regulations, and local directives and policies. Before examining various software systems, you should become familiar with the acquisition process and review appropriate regulations such as DODI 1322.20, Development and Management of Interactive Courseware for Military Training; MIL-HDBK-284, Interactive Courseware for Military Training; and MIL-STD-1379D, Military Training Programs.
Definition of Authoring Software	Authoring software is a special set of computer instructions used to create the individual displays that make up ICW lessons. These instructions are used by the courseware developer to tell the computer how the lesson should look and operate.
Types of Authoring Software	<p>There are three types of ICW authoring software:</p> <ul style="list-style-type: none">• Authoring Language• Authoring System• Ancillary Software

**Description of
Authoring
Software**

The following is a description of the three types of authoring software.

Type of Authoring Software	Description
Authoring Languages	An authoring language is a specialized, high-level, plain English, language-like computer program (often based on another computer language like BASIC or PASCAL). Authoring languages are flexible and can meet a full range of instructional needs but are frequently difficult to learn and use by anyone who does not have a computer programming background. An example of an ICW authoring language is TenCore Language Authoring System (LAS).
Authoring System	An authoring system (often referred to as an authoring package) is a prepackaged, prompted authoring aid, courseware template, or menu-driven editor designed to help authors (without formal computer programming skills) create ICW without elaborate programming. Examples of IVD authoring systems are Quest, TenCore Producer, Mandarin, and WISE. Examples of authoring systems for digital formats are Toolbook, MediaScript, QuickTime, Authorware Professional, Authology, and Video for Windows.
Ancillary Software	Ancillary software refers to commercial, off-the-shelf software packages or tools used with authoring software. Examples of ancillary software are: <ul style="list-style-type: none"> • Word processing software • Graphics software • Flowcharting software • Storyboarding tools • Computer-managed instruction (CMI) software

**Restrictions for
Using Ancillary
Software**

There are three restrictions for using ancillary software. The following is a description of the three restrictions.

Restriction	Description
1	The authoring and ancillary software must use the same operating system. Windows, MS-DOS, UNIX, Macintosh System 7, and OS/2 are major operating systems.
2	The authoring software must have the capability to import the code generated by the ancillary software.
3	The authoring software must be able to understand the imported code.

Authoring Software Capabilities

Table 4 shows authoring software capabilities of authoring languages and authoring systems.

Table 4. Authoring Software Characteristics

R U L E	A	B
	Authoring Languages	Authoring Systems
1	Extensive CMI capabilities	Limits on CMI
2	Programming language available (for developing utilities to increase efficiency)	Programming language may or may not be available
3	Sophisticated branching	Some systems limited on branching
4	Flexible screen design	Structured screen design
5	Programming required	Programming not required

Technology Advances with ICW Software

As technology advances, the distinction between authoring languages and authoring systems is becoming less defined. New versions of authoring languages incorporating selection menus are on the market today. Similarly, some authoring systems incorporate a programming language to enhance flexibility.

Authoring Software Decisions

Typically, you will not need to decide whether to use an authoring language or an authoring system. Because of the ease of implementation and the flexibility and power now available with most authoring systems, the decision you are more likely to be faced with is **which authoring system** you should use. The information presented below will help you make this decision.

**Key Capabilities
of Authoring
Systems**

For authoring systems to facilitate development of ICW, a variety of key capabilities are required. Decision Aid 3 for selection of authoring system capabilities divides the capabilities into two major categories:

- Authoring and presentation capabilities
- CMI capabilities

Here is a description of Authoring and Presentation and CMI capabilities.

Type of Capability	Description
Authoring and Presentation	<p>Authoring/ presentation capabilities assist in performing such authoring tasks as:</p> <ul style="list-style-type: none"> • Developing or editing text displays • Creating or editing graphics • Animating graphics • Developing written questions and response analysis • Creating performance questions • Programming video sequences • Sequencing lesson material • Using utilities
CMI	<p>CMI capabilities are available to manage instruction. Categories for CMI capabilities are:</p> <ul style="list-style-type: none"> • Administration • Record keeping • Schedule generation • Answer judging • Report generation

Authoring systems or packages vary with regard to the authoring and presentation capabilities and specific CMI capabilities listed above.

**Decision Aid 3:
Selection and
Tradeoff
Analysis of
Authoring
Software
Capabilities**

Decision Aid 3 concerns Phase I of the selection process. Use this decision aid to determine which software capabilities are required or desired for the proposed ICW training.

**How To Use
Decision Aid 3**

Check off whether the authoring/presentation or CMI capability is required or desired on Decision Aid 3. At this time **do not** concern yourself with the columns labeled 1 and 2. These columns will be used when you get to Phase II, the tradeoff analysis.

**How To Use
Decision Aid 3
(Continued)**

Note: If you do not know what something on the list means, find a computer programmer, an instructional designer or courseware designer to help you.

**Select Software
Packages for
Tradeoff
Analysis**

Once you have identified the required or desired capabilities, **select two authoring software packages** based on your previous decisions. There are several monthly periodicals dedicated to ICW development. These magazines have reviews of the most current authoring systems, and are an excellent place to start your research. Assign an identification code (1 or 2) to each of the two software packages chosen for comparison. Use Table 5, Software Package Information Requirements, as a guide to obtain information about each software package. Record your findings on a separate piece of paper. Once you finish recording your findings, return to Decision Aid 3 for authoring/presentation and CMI capabilities for the tradeoff analysis.

**How To Use
Decision Aid 3
for the Tradeoff
Analysis**

Use the information concerning required or desired capabilities to compare these capabilities with the capabilities of the software packages. Select the authoring system that is within the acquisition budget and which provides the capabilities **that most closely match** your requirements and desires.

Note: Decision Aid 3 will help you make a decision by helping you to remember all the things you should think about during your selection. There may not be a clear-cut answer. Selection of an authoring system is based on preference and results of the tradeoff analysis.

**Decision Aid 3. Selection and Tradeoff Analysis of
Authoring Software Capabilities**

Authoring/Presentation Capabilities	Required	Desired	1	2
1. Developing and Editing Text Displays				
a. Coded text entry				
b. Direct text entry at cursor location				
c. Template text entry				
d. Menu prompting				
e. Command prompting				
f. Predesigned screen layout				
g. 80 text columns				
h. 40 text columns				
i. Both 80 and 40 text columns				

Continued

**Decision Aid 3. Selection and Tradeoff Analysis of
Authoring Software Capabilities (Continued)**

Authoring/Presentation Capabilities	Required	Desired	1	2
j. Fonts				
k. Special characters				
l. Character set generation				
m. Color for emphasizing text				
n. Line editing				
o. Screen editing				
p. Text manipulation				
q. Interface with word processing				
r. Interface with touch screen, mouse, track ball, or light pen to identify screen coordinates for text location				
2. Creating and Editing Graphics				
a. Cursor draw				
b. Common shapes drawn after definition				
c. Area fill and patterns				
d. Graphics library for storing images				
e. Vendor-developed library graphics				
f. Library graphics modification and use				
g. Graphic sizing				
h. Graphic rotation				
i. Color palette with 64 colors, 16 simultaneous				
j. Color palette with 16 colors, 4 simultaneous				
k. Screen editing				

Continued

**Decision Aid 3. Selection and Tradeoff Analysis of
Authoring Software Capabilities (Continued)**

Authoring/Presentation Capabilities	Required	Desired	1	2
l. Interface with touch screen, mouse, track ball, or light pen to identify screen coordinates for graphic placement				
m. Interface with digital pad				
n. Interface with graphics package				
3. Animating Graphics				
a. Color palette with at least 16 simultaneous colors				
b. Blinking				
c. Replotting along specified path				
d. Animation limited to one shape				
e. Animation of more than one shape				
f. Interface with touch screen, mouse, track ball, or light pen to identify screen coordinates for animated image specification or path identification				
4. Developing Written Questions and Response Analysis				
a. Multiple choice				
b. True/False				
c. Matching				
d. Completion				
e. Fill-in-the-blank				
f. Numeric				
g. Predefined question format				
h. Question templates				
i. Use of wild card for text input				

Continued

**Decision Aid 3. Selection and Tradeoff Analysis of
Authoring Software Capabilities (Continued)**

Authoring/Presentation Capabilities	Required	Desired	1	2
j. Range specification for numeric answers				
k. Truncation of numeric answers				
5. Creating Performance Questions				
a. Animation				
b. Touch input accepted				
c. Interface with touch screen, mouse, track ball, or light pen to initiate part-task performance				
6. Programming Video Sequences				
a. Direct access of video frame during authoring				
b. Graphic overlay				
c. Video windows				
d. Text integration				
e. Pause motion sequence				
f. Step backward				
g. Step forward				
h. Touch input accepted				
7. Sequencing Lesson Material				
a. Page forward				
b. Page backward				
c. Access lesson section through a lesson menu				
d. Return to section beginning				
e. Return to lesson menu				
f. Access help routines				
g. Replot graphics				
h. Replay video sequence				

Continued

**Decision Aid 3. Selection and Tradeoff Analysis of
Authoring Software Capabilities (Continued)**

Authoring/Presentation Capabilities	Required	Desired	1	2
i. Conditional branching based on student input				
j. Terminate lesson				
k. Return to lesson beginning				
8. Using Utilities				
a. Screen copy				
b. Lesson hard copy output				
c. ASCII file importation				
d. Programming language for developing utilities				
CMI Capabilities				
9. Administration				
a. Student enrollment in ICW course				
b. Multiple registrar functions				
c. Course listing				
d. Lesson listing				
e. Course or lesson documentation				
f. Bookmarking				
10. Record Keeping				
a. Duration of lesson session				
b. Embedded practice scores				
c. Test scores				
d. Individual responses to practice questions				
e. Individual responses to test questions				
f. Lesson mastery records				

Continued

**Decision Aid 3. Selection and Tradeoff Analysis of
Authoring Software Capabilities (Continued)**

CMI Capabilities	Required	Desired	1	2
g. Number of response attempts to practice questions				
h. Number of response attempts to test questions				
i. Duration of test sessions				
j. Statistical analysis of records				
k. Item analysis of test questions				
11. Schedule Generation				
a. Students				
b. Classes				
c. Instructors				
d. Equipment				
e. Facilities				
12. Prescription				
a. Link objectives to lessons				
b. Link pretest to objectives				
c. Prescribe remediation				
d. Prescribe acceleration				
13. Report Generation				
a. Online student reports for individual feedback				
b. Online reports for student or class monitoring				
c. Printed reports				
d. Custom report format design				
e. Report student data				
f. Report class data				
g. Report lesson data				
h. Report course data				

**Factors
Influencing
Selection of
Authoring
Systems**

Authoring systems should be analyzed for the following selection factors:

- Capability to support instructional design
- Ease of implementation
- Hardware compatibility
- Use of existing software
- Cost
- Vendor support and reputation
- Licensing arrangements (see Table 41, #2, page 129)

**Authoring
Software
Selection
Decision Aids**

Selecting authoring systems is generally the outcome of a tradeoff analysis. There are two phases to the selection process:

Phase	What You Do
I	Select the authoring capabilities you believe are required or desired.
II	Conduct a tradeoff analysis comparing two or more authoring software packages.

Table 5. Software Package Information Requirements

Information Requirements
1. General Information
a. Name of software package and version number
b. Vendor's address and phone number
c. Software identification code
d. Reviewer's name and phone number
e. Review date
2. Software Characteristics
a. Description of text entry and editing procedures
b. Description of color selection procedures
c. Description of graphics creating and editing procedures
d. Description of animation procedures
e. Description of video editing procedures

Continued

Table 5. Software Package Information Requirements (Continued)

Information Requirements	
f.	Description of procedures for sequencing displays (indicating branching strategies)
g.	Description of procedures for specifying CMI functions
h.	Operating system needed to run the software
i.	RAM needed to run the software (does the selected hardware have it?)
3. Costing Information	
a.	Cost of individually purchased software package
b.	Amount of run time given with initial purchase
c.	Number of software packages needed for ICW development
d.	Cost of site license
e.	Comparison of cost of site license and cost of purchasing individual software packages
4. Software Support	
a.	Description of available user support
b.	Peripheral support such as audio, printer, mouse, joystick, network capability, touch screen, light pen, and optical scanner

**Software
Requirements for
Digital Formats**

Here is information regarding software requirements for digital formats.

Type of Software	Impact on All-Digital Format
Authoring Languages	If you are working in an all-digital format you can use any programming language for MS/DOS, OS/2, Windows, or Macintosh operating system.
Authoring Systems	The following authoring systems will work with current digital hardware: Mediascript, Authology, Authorware Professional, Multimedia Toolbook, Video for Windows, True Motion, Indeo.

Section D

ICW Hardware Configuration Decisions

Introduction	This section addresses hardware selection and describes the impact that hardware decisions have on ICW. Decision aids for selecting authoring hardware are presented.
Goal of Hardware Configuration Decisions	The goal is to choose a configuration that supports a variety of parameters, including the previously selected ICW instructional features and the authoring system.
What You Need	Personnel with a hardware background are required for this phase of the ICW decision-making process.
Review Policies and Regulations	The ICW hardware decision is based on a number of selection factors, military acquisition restrictions, command regulations, and local directives and policies. Before examining various hardware systems, you should become familiar with the acquisition process and review appropriate regulations such as DODI 1322.20, Development and Management of Interactive Courseware for Military Training; MIL-HDBK-284, Interactive Courseware for Military Training; and MIL-STD-1379D, Military Training Programs. Be sure to review the hardware requirements specified in MIL-STD-1379D, Appendix D, paragraph 40.1, before selecting a system.
Factors Influencing Hardware Selection	<p>After you review regulations and determine how restrictions affect the selection process, you should examine specific hardware systems for the following selection of factors:</p> <ul style="list-style-type: none">• Interface with authoring software• Processing speed• Capability to support multimedia design• Exportability• Existing hardware• Cost• Vendor support and reputation
Delivery Platforms	Multimedia is rapidly becoming a standard to be met in the delivery of instruction. There are two primary delivery platforms competing for market shares: Macintosh and PC DOS-based hardware. Within the PC market, there are two types of multimedia delivery: DOS-based and Windows Graphical Environment (WGE). Each type of platform allows delivery of multiple resources (video, audio and graphics).

**Hardware
Selection Phases**

Selecting hardware is generally done by conducting a tradeoff analysis. Before conducting the analysis, you need to identify the basic computer configuration and the specific hardware capabilities. There are five decision aids to help you through the hardware decision process:

Decision Aid	Name	See Page
4	Selection of Configuration Type	32
5	Selection of Processing Type for Networking	33
6	Selection of Central Computer Type for Networking	34
7	Selection of Input and Output Devices for Development of Delivery Stations	36
8	Hardware Tradeoff Analysis Data Collection	37

**Decision Aid 4:
Selection of
Configuration
Type**

The first phase of the hardware decision process is selection of basic computer configuration, that is, determining whether the system is to be networked or stand-alone. Decision Aid 4, Selection of Configuration Type, will help you with this decision. Table 6 shows the distinguishing characteristics used to discriminate between a networking requirement and a stand-alone requirement.

**How To Use
Decision Aid 4**

Use Decision Aid 4 to determine configuration requirements. Three or more "yes" responses indicate a requirement for networking.

Decision Aid 4. Selection of Configuration Type

Decision Factor	Yes	No
Comprehensive CMI required*		
Moderately sized to large user group anticipated		
Frequent ICW access required		
Secure testing required*		
Local training (only) required**		

*Especially critical in the decision-making process because this requirement demands a network.

**Critical because a "no" response reflects an exportable training requirement and a stand-alone system.

Table 6. Hardware Configuration Characteristics

R U L E	A	B
	Network	Stand-Alone
1	Supports comprehensive CMI requirements	May not support comprehensive CMI requirements
2	Supports moderately sized to large user group (25+)	Supports small user group (<25)
3	Supports frequent lesson access (daily, weekly)	Supports infrequent lesson access (monthly, quarterly). Depending on applications, stand-alone systems do support frequent lesson access (daily, weekly).
4	Fully supports secure testing requirements	Does not support fully secure testing requirements
5	Supports local training	Supports exportable training

**Decision Aid 5:
Selection of
Processing Type
for Networking**

Use Decision Aid 5 **only if networking was chosen as the configuration**. Decision Aid 5 will help you select the type of processing for a networked configuration. Table 7 lists the prominent characteristics of centralized and decentralized processing.

**How To Use
Decision Aid 5**

Use Decision Aid 5 to determine the type of processing needed to support your training. Select centralized processing **if any of the questions are answered "yes"**.

Decision Aid 5. Selection of Processing Type for Networking

Decision Factor	Yes	No
Widely dispersed local training expected		
Terminal-to-terminal interactive training required		
Frequent student record update expected		

Table 7. Processing Type Characteristics

R U L E	A	B
	Centralized Processing (Host Computer)	Decentralized Processing (File Server)
1	Supports widely dispersed local use (classrooms spread throughout base)	Supports nondispersed local use (classrooms in close proximity)
2	Easily supports training with terminal- to-terminal interaction (e.g., crew coordination training)	Supports terminal-to-terminal interaction with substantial design and development expense
3	Supports frequent student record updates	Supports infrequent student record updates

**Decision Aid 6:
Selection of
Central
Computer Type
for Networking**

Use Decision Aid 6 **only if networking was chosen as the type of configuration**. Table 8 describes the primary characteristics of the three central computer types.

**How To Use
Decision Aid 6**

Use Decision Aid 6 to select a central computer type for networking. Based on the number of students, lessons, and computer graphics, "x's" indicate which computer type you should use.

Decision Aid 6. Selection of Central Computer Type for Networking

		Mainframe	Minicomputer	Microcomputer
Number of students	10-50			X
	10-100		X	
	100+	X		
Number of lessons	10-50			X
	10-200		X	
	200+	X		
Number of computer graphics	0-50			X
	50-250		X	

	200+	X		
--	------	---	--	--

Table 8. Central Computer Characteristics

I T E M	A	B	C
	Mainframe	Minicomputer	Microcomputer
1	Number of students accessing the network at one time exceeds 100	Number of students accessing the network at one time is between 10 and 100	Number of students accessing the network at one time is between 10 and 50
2	Number of instructional contact hours exceeds 200	Number of contact hours is between 10 and 200	Number of contact hours is between 10 and 50
3	Number of complex static or animated graphics exceeds 200	Number of complex static or animated graphics is between 50 and 250	Number of complex static or animated graphics is between 0 and 50

**Decision Aid 7:
Selection of Input
and Output
Devices for
Development of
Delivery Stations**

Use Decision Aid 7 in the hardware decision process to determine the input and output requirements for the ICW development and delivery stations.

**How To Use
Decision Aid 7**

Use Decision Aid 7 to select the input devices needed for both the ICW developer and the student to interact with the ICW and to determine the output devices for the development and delivery stations.

**Selection of
Output Devices**

Selection of output devices (monitor type and video controller card) depends on the instructional presentational features. You should always try to select a monitor type and video controller card with the screen resolution most appropriate to your need. The most commonly used video controller card currently available is VGA. VGA is the standard for graphics and video controller cards. There are also special boards available for very-high-resolution applications requiring 24- or 32-bit color. Probably the only reason you would ever select a monochrome monitor and an EGA graphics card would be if the system was already available and the ICW had no requirement for color or complex graphics and animation or full-motion video.

**Decision Aid 7. Selection of Input and Output Devices
for Development of Delivery Stations**

Input Device		Delivery Station		Development Station			
Joystick							
Track ball							
Mouse							
Touch-sensitive monitor							
Light pen							
Keyboard							
Key pad							
Bit pad							
Microphone							
Output Device	Monitor Type			Controller Card			
	Mono	RGB	Grey	Mono	CGA	EGA	VGA
Static graphics	X	X	X	X	X	X	X
Animated graphics		X	X			X	X
Part-task simulation		X				X	X
IVD		X				X	X
Digital		X					X

**Decision Aid 8:
Hardware
Tradeoff
Analysis Data
Collection**

After determining the basic configuration and input and output requirements, conduct a tradeoff analysis. Use Decision Aid 8 to see if **available** hardware meets your needs.

**How To Use
Decision Aid 8**

If your needs cannot be met using available hardware, contact two to five computer vendors and talk to them about their systems. Get them to send you literature if possible. (NOTE: Make it perfectly clear, however, that you are not in a contractual position and cannot obligate the Government. You want information only.) Use Decision Aid 8 when reviewing these systems. Select the system that is within your budget and comes closest to meeting your requirements.

Decision Aid 8. Hardware Tradeoff Analysis Data Collection

Information Requirements
1. General Information
a. Name of hardware system
b. Vendor's address
c. Vendor's phone number
d. Reviewer's name and phone number
e. Review date
2. Hardware Characteristics
a. Operating system
b. Network support
c. Number of users supported by network
d. Delivery speed
e. Speed of lesson access from network
f. Graphic and text plot speed
g. System response to input
h. Input devices supported by the system
i. Type of monitor delivered with the system (monochrome, grey, RGB)
j. Cost of a different monitor if necessary
k. Graphics/video controller card with the system (high resolution mono, CGA, EGA, VGA)
l. Cost of a different graphics/video controller card if necessary
m. Cost of hardware system
n. What is included in this cost (specific components, documentation, user support, maintenance and system integration)

- o. Items that can be added later to extend the system (for example, RAM, networking software, larger storage, higher resolution monitor, graphics/video controller cards, input devices, and videodisc players)

Continued

Decision Aid 8. Hardware Tradeoff Analysis Data Collection (Continued)

Information Requirements	
p.	Standard maintenance offers as part of the purchase
q.	Specific maintenance support included in a standard agreement
r.	Components under warranty
s.	Length of the warranty period
t.	Cost of extending the maintenance agreement
u.	Ongoing user support available at no additional charge (telephone support, user-friendly documentation)

Section E

Management and Organizational Support Decisions

Introduction

This section shows you how to examine your organization to determine if support for ICW exists. Successful implementation of ICW depends on:

- Management support
- Staff support
- Proper facilities

Management Support

There are three general types of management support required:

- Commitment of funds
- Enthusiasm for project
- Ability to meet staff demands

Here is a description of the three general types of management support.

Type of Support	Description
Commitment of Funds	Upper-level management support is needed for successful ICW implementation. Management controls the spending of funds. On ICW projects, funds may be needed for: <ul style="list-style-type: none"> • Purchasing hardware and software • Training the ICW development staff • Training personnel on their changing roles related to ICW projects
Enthusiasm for Project	Enthusiastic managers can serve as project advocates and promote an atmosphere of cooperation throughout the training organization. Managers can reduce negative attitudes by their enthusiasm for a project.
Meeting staffing demands	Management support is essential in meeting staffing demands. The selection, assignment, and training of personnel should be a major concern. Management should assign personnel to the project from start to finish. Although assignment longevity is hard to achieve in a military environment, it is a critical factor to the success of an ICW project. Personnel rotation can slow the ICW process because of learning curves for new employees, and different perceptions of what is needed.

Staff Support ICW development requires staff members with a variety of experience. Table 9 shows the basic ICW team composition. It lists the ICW staff positions and describes the specific responsibilities assigned.

Table 9. ICW Development Team

R U L E	A	B
	Position Title	Responsibilities
1	Courseware developer (CD)	Authors lesson designs, flowcharts, and storyboards. Designs and/or creates static and animated graphics, performance exercise, simulations, and interactive sequences. Programs lessons with authoring systems.
2	Instructional designer (ID)	Develops standards and instructional strategies for ICW lessons. Assists with lesson authoring when required. Reviews completed lesson designs, flowcharts, and storyboards for instructional integrity and conformance with standards and strategies.
3	Subject matter expert (SME)	Provides information on ICW subject matter. Reviews lesson designs, flowcharts, storyboards, and programmed lessons for accuracy and currency. Authors lessons as required.
4	Courseware programmer (CP)	Programs lessons with authoring languages. Develops static and animated graphics with authoring languages. Assists in ASCII code conversion when automatic conversion is unavailable.
5	Graphic artist (GA)	Develops graphics on paper for inclusion as an interactive still-frame. May develop initial illustrations for complex computer-generated graphics.
6	Computer artist (CA)	Develops computer-generated graphics for inclusion as a still-frame.
7	Media specialist (MS)	Films motion and still-frame sequences. Coordinates audio narration. Assists in planning premaster tape layout.

ICW Implementation Team After ICW is developed, a team of personnel with specific responsibilities is needed to implement the program. Table 10 shows the ICW implementation team composition and lists the position titles and responsibilities of the team members.

Table 10. ICW Implementation Team

R U L E	A	B
	Position Title	Responsibilities
1	Resource manager	Catalogs, stores, and distributes courseware materials including student guides, workbooks, flowcharts, storyboard hard copy, lesson design hard copy, flowcharts, lesson disks, backup disks or tapes, and version updates.
2	Courseware administrator	Enrolls students in ICW. Tracks student progress through CMI reports. Maintains records on student progression. Provides student progression records to instructors.
3	System administrator	Sets up and runs computer laboratories. Contacts vendor for unscheduled maintenance. Trains staff to use the hardware system.
4	Class monitor (see note)	Assists students using ICW. Responds to operational questions and monitors performance using CMI. Updates instructors on student performance.
5	Instructor (see note)	Provides individual remedial instruction and counseling. Tracks student performance through CMI. Schedules students for remediation. May also participate in ICW development as courseware developer, instructional design, or subject matter expert.

NOTE: This position is not required in an exportable environment, but the responsibilities identified in this table may be required. You may have to redistribute these responsibilities to another labor category on the exportable courseware implementation team.

Decision Aid 9: Use Decision Aid 9 to evaluate the level of organizational support for ICW.
Evaluation of Organizational Support for ICW

How To Use Decision Aid 9 Lack of support in any of the categories listed can lead to serious consequences, but a support deficit does NOT necessarily eliminate the use of ICW.

Decision Aid 9. Evaluation of Organizational Support for ICW

I T E M	A	B	C	
	Support Category	Evaluation Procedure	Support is	
			Available	Unavailable
1	Management support	Talk to managers to determine their support for ICW.		
2	Staff support	Talk to staff to determine support for ICW.		
3	Staff availability	Review future commitments for staff. Determine whether staff can be added.		
4	Staff skills	Review staff resumes. Interview staff about prior ICW experience.		
5	Staff dedication	Review future commitments for staff.		

Decision Aid 10: Use Decision Aid 10 to identify an action and develop a plan for altering the level of organizational support.
Modification of Support Level

How To Use Decision Aid 10	Decision Aid 10 lists the critical support categories, the potential results of a support deficit, and suggested actions to reduce the deficit or increase the level of support.
---------------------------------------	--

Decision Aid 10. Modification of Support Level

I T E M	A	B	C
	Support Category	Results of Support Deficit	Action to Alter Deficit
1	Management support	May have funding problems. Lack of support may flow down through organization.	Inform management of ICW advantages and benefits. Involve managers in the decision process or planning phase.
2	Staff support	Instructors may resist the change and be uncooperative during implementation.	Provide training on ICW to reduce resistance. Convince staff that changing roles does not mean less responsibility. Involve staff in decision process.
3	Staff availability	May not have the force to develop ICW.	Add staff to current force. Defer current commitments. Contract out ICW development.
4	Staff skills	Learning curve will be high. Development will proceed slowly.	Train staff to perform ICW development. Contract out development. Add experienced staff to current force.
5	Staff dedication	Lesson revisions increase with ICW staff changes.	Develop and enforce lesson standards to reduce potential for format changes.

Decision Aid 11: Organizational Support Reevaluation Use Decision Aid 11 to **reevaluate** organizational support based on the data collected on Decision Aids 9 and 10.

How To Use Decision Aid 11 If support is now available in three of five categories (one **must** be management), pursue ICW. If the reevaluation still reflects a substantial support deficit and you still pursue ICW, you should **anticipate** additional problems in meeting schedules.

Decision Aid 11. Organizational Support Reevaluation

I T E M	A	B	
	Support Category	Support is	
		Available	Unavailable
1	Management support		
2	Staff support		
3	Staff availability		
4	Staff skills		
5	Staff dedication		

**Decision Aid 12:
Contractor
Support
Characteristics**

One potential solution to a support deficit in the area of staffing requirements is **contracting** ICW to a commercial training development company.

**How To Use
Decision Aid 12**

Use Decision Aid 12 to determine if contractor support is required.

Decision Aid 12. Contractor Support Determination

I T E M	Decision Factor		
		Yes	No
1	Development schedule less than 6 months (see note).		
2	Number of 1-hour lessons exceeds 50 (see note).		
3	Inadequate staffing support for ICW (see note).		
4	Adequate staff available but inexperienced with ICW.		
5	Staff dedication to ICW unreasonable.		
6	Contract monies available.		

NOTE: May be adequate support for pursuing contractor assistance.

**Facility
Requirements**

A number of facility requirements affect implementation of ICW:

- Delivery system facility requirements
- Development system facility requirements
- Special facility requirements

Here is a description of the three types of facility requirements.

Type of Requirement	Description
Delivery System Facility Requirements	You will need a room to house the delivery hardware systems. This room must be large enough to house a learning station for each student. Partitions are often used around the learning stations to provide privacy for the students. The learning station should also have storage space for supplemental materials (workbooks, laser discs, diskettes) and work space for the students. If systems are networked, space must also be available for the system used to monitor CMI. Space may also be needed if a printer is used.
Development System Facility Requirements	Each member of the development team will need work space and special resources. For example, the graphic artist may need a drafting table and a computer system. The medial specialist may need access to a video lab and audio recording studio.
Special Facility Requirements	The rooms housing the development and delivery systems should have adequate cooling and power. Rooms with networked systems must provide storage for cabling that links each system with the file server or host computer.

Section F

ICW Cost Considerations

Introduction This section explains how direct and indirect costs can affect your decision to use ICW. This section also presents a methodology for estimating the amount of time it will take to produce one hour of finished ICW.

Cost Factors The final decision about using ICW cannot be made until direct and indirect costs are known. Here is a description of direct and indirect costs.

Type of Cost	Description
Direct Cost	A direct cost is any cost that is specifically identifiable to the project. Examples of direct costs are hardware and software purchases, travel and per diem costs, and time charges to a specific project. Other direct costs include reproduction costs of ICW materials including laser discs, costs to copy floppy diskettes, and video production costs.
Indirect Cost	An indirect cost is any cost that is not specifically identifiable to the project. Examples of indirect costs are payroll and administrative costs, electric bills, and basic overhead accounts. Another example of an indirect cost is the money required to train a programmer on a particular authoring system if the costs are not charged directly to a specific project. Monies associated with modifying or constructing the ICW facilities could be indirect costs.

Estimating ICW Development Hours Table 11 provides a baseline estimate from which you can begin the process of determining the total number of hours it will take to design, develop, and evaluate one hour of ICW. The table shows a baseline estimate based on experience from Air Force ICW projects. The estimates are broken down into level of presentation and type of training. Program management time is included in the estimates.

Table 11. Estimated Hours of Development for One Hour of ICW

Level of Presentation	Air Force Estimate	Type of Training		
		Knowledge	Skill	Attitude
I - Basic	30-200	30	75	200
II - Medium	75-250	75	125	250
III - High	200-600	200	400	600

Here is a description of each level of presentation.

Level of Presentation	Description
Level I	Basic Presentation. This is the lowest level of ICW development in that Level I lessons are linear (one idea after another), and are used primarily for introducing an idea or concept. There is little "interaction" other than the student touching the screen or using a keystroke or mouse click to continue. The media used are primarily text and graphics (not complex).
Level II	Medium Simulation Presentation. This presentation level involves the recall of more information than a basic Level I presentation and allows the student to have increased control over lesson presentation; that is, there is more interaction, such as using a light pen to rotate a switch. CMI is used in Level II lessons to track and analyze student performance. Level II normally combines audio, video, text, graphics and animation.
Level III	High Simulation Presentation. This level involves aspects of both Level I and Level II while using the full abilities of ICW. Level III may present onscreen interaction similar to that used in an aircraft simulator. This level provides a high degree of interactivity, extensive branching capability, maximum remediation opportunity (supports multiple levels of errors), real-time event simulation with minor equipment limitations, capability to interface with other output devices, and thorough CMI capability.

Here is a description of each type of training.

Type of Training	Description
Knowledge	A knowledge objective involves the use of mental processes which enable a person to recall facts, identify concepts, and apply rules or principles. An example of a knowledge objective is knowing how the fuel flows through an aircraft system. A person manifests knowledge through performing associated overt activities. Although knowledge is not directly observable, it is measurable.
Skill	Skill objectives are commonly described in terms of hard skills and soft skills. Hard skills involve physical or manipulative activities, such as operating or maintaining a piece of equipment. Soft skills often require interpersonal activities such as conducting an interview. Hard and soft skills are directly observable and measurable.
Attitude	An attitude is a persisting state that influences or modifies an individual's choices or decisions to act under certain circumstances. An attitude objective represents a tendency on the part of the learner to respond in a particular way. An example of an attitude objective is choosing to wear a seat belt. Attitude objectives may be difficult to observe and measure.

Assumptions for Estimating Development Hours

The hours provided in Table 11 assume a "best case" situation. Here is a list of factors which define a "best case" situation.

- The ICW developer is familiar with the subject matter, and has in-house subject matter experts.
- The subject matter is not highly complex.
- The instructional content is stable; that is, the system for which the training is being developed exists and is not emerging. Also, the tasks selected for ICW training do not continually change.
- The instructional content is well documented. A training needs assessment and task and learning analysis have been completed, giving the designer a good idea of the performance expected and the tasks to be trained. The technical materials supporting the content domain are accurate.
- The total ICW course length is 100 hours or more and the development process will be accomplished within one year.
- The ICW developer is familiar with the selected ICW authoring software.
- The ICW developer is familiar with the target audience.
- There is no requirement to document to a MIL-STD such as 2167A, and best commercial practices are accepted for software development and video production.

**Assumptions for
Estimating
Development
Hours
(Continued)**

- The ICW project team consists of individuals who are experienced with ICW management, design and development.
- The selected ICW authoring system is mature and stable. No beta versions are used.
- A lesson format and design strategy are agreed upon "up front", and the customer has "bought into" it. If possible, the customer has approved a prototype lesson. Also, the development process is standardized.
- The customer works closely with the design team on a regular basis. The customer uses an objective acceptance criteria and does not continually change the individual who is responsible for reviewing and approving the lessons.
- All required resources are in place.

**Effect of Changes
in Variables**

Table 12 illustrates how the development hours will increase if the factors described above are not present. Estimates are also provided regarding the amount of risk associated with each variable.

Table 12. Variables Affecting Time Estimates for ICW

Variables	Increase Hours By:	<u>Risk (Scale 1-5)</u>				
		None			High	
		1	2	3	4	5
1. No "in-house" SMEs; must rely solely on use of customer SMEs.	25:1				2	
2. Subject matter is highly complex.	100:1				4	
3. Instructional content is unstable. System for which ICW being developed is emerging. Tasks for ICW constantly changing.	100:1			5		
4. Inadequate documentation. No training needs assessment was performed. No task analysis or learning analysis data. Technical manuals/orders non-existent or not helpful.	20:1				4	
5. Total ICW course length <100 hours. (less potential for use of templates, shells, etc.)	20:1				1	

Continued

Table 12. Variables Affecting Time Estimates for ICW (Continued)

Variables	Increase Hours By:	<u>Risk (Scale 1-5)</u>				
		None			High	
		1	2	3	4	5
6. ICW developer not familiar with ICW software/authoring package.	15:1				2	
7. ICW developer not familiar with target audience.	10:1				2	
8. Best commercial practices not acceptable for video, graphics production, and software development. Must develop to a MIL-STD specification and deliver large amount of documentation.	50:1				2	
9. Inexperienced project team:						
ICW designers inexperienced	80:1				3	
ICW manager inexperienced						
ICW programmer inexperienced	100:1					
	60:1				4	
10. Using a beta version of the ICW software.	80:1				4	
11. No prototype exists, no agreement "up front" on design strategy, no standardized development process followed.	50:1				5	
12. Customer not using objective and consistent acceptance criteria. Customer unsure of what he wants and does not communicate with developer.	50:1				5	
13. Required resources not in place at start of project.	20:1				1	

Estimating Labor Hours to Produce ICW Use the information in Tables 11 and 12 to estimate the hours required to design, develop, evaluate and produce ICW.

Example of Using Tables 11 and 12 Assume that Level II ICW is being estimated to train a skill. The product to be developed is IVD, and the course length is estimated at 100 hours. You are familiar with the software and have experienced people. The programming and video production will be completed "in house." There are no MIL-STD requirements; however, no training needs assessment has been performed and the subject matter is highly complex (add 100 hours). You do not have in-house subject matter experts (add 25 hours). The instructional content is stable but the documentation is poor (add 20 hours). You are not familiar with the target audience (add 10 hours). Beginning with the number 125 (the hours it would take to develop one hour given the "best case" situation), you should add a total of 155 hours to the estimate, bringing the total up to 280 hours.

Estimating Costs for Course Configuration and Maintenance Table 13 gives examples of the typical kinds of changes often encountered during ICW development. The table shows the number of hours commonly associated with minor, moderate, and major changes. The hour estimates can be used to help the ICW manager determine if the change will require additional funds to implement.

Table 13. Configuration Control Decision Matrix

Type of Change	Level of Change		
	Minor	Moderate	Major
Technical	Example: switch position is wrong	Example: functioning of an entire component must be changed due to an equipment modification	Example: introduce entire set of new tasks
Instructional	Example: allow student two tries instead of one	Example: change one test from multiple choice to true/false	Example: introduce entire new strategy on how to test
Media	Example: change font	Example: add four full-motion video shots	Example: replace all graphics with video
Hours (to drive decision)	<40	Judgment call 40-160	>160

Estimating Labor Hours to Produce ICW (Continued) Here is a description of the type of changes you can expect during the ICW development process.

Type of Change	Description
Minor changes	Minor changes typically are those requiring less than 40 labor hours to complete. Minor changes rarely require additional funds.
Moderate changes	Moderate changes often require "judgment calls" to determine whether more funds are necessary. Often a moderate change can be made if some other aspect of the course design is reduced.
Major changes	Major changes are those requiring more than 60 labor hours to accomplish, and most likely will result in the requirement to add funds to the project.

Chapter 3

HOW TO PLAN AN IN-HOUSE ICW EFFORT

Overview

Introduction

The first step to deliver a quality ICW program to your customer is to develop a project plan. Without a well-developed project plan, neither you nor your customer will know what to expect, when to expect it, or how well it should work. Customer dissatisfaction at product delivery is often due to a lack of communication with the customer during the project. The project plan is a convenient tool to use to communicate with your customer. This chapter describes all of the activities performed during the planning phase of an ICW program.

Where To Read About It

This chapter contains three sections.

Section	Title	See Page
A	Outline the ICW Effort	55
B	Prepare the Project Team	58
C	Develop Quality Control Procedures	59

Additional Information

For additional information on planning an ICW effort, see:

- Alessi, S. M. and Trollip, S. R. (1985). *Computer-based Instruction Methods and Development*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.
-

Section A

Outline the ICW Effort

Introduction

Procedures for outlining the ICW development effort are described in this section. There are four steps to outlining the ICW effort.

Step 1	Establish a development process.
Step 2	Determine project deliverables.
Step 3	Define staff positions and responsibilities.
Step 4	Develop a master schedule.

Establish a Development Process

Think through the entire development process and prepare a list of steps required for each phase. Table 14 is an example of such a list. Not all the steps shown in this table are needed for every project, and the last three steps apply only to projects in which IVD is the delivery system. Once you select the steps as listed, briefly write out the following information:

- Purpose of the step
- Products resulting from the step
- Documentation used in developing the products
- Personnel responsible for the step
- Review and approval process for the step

Determine Project Deliverables

The project plan should clearly spell out what products you will deliver to your customer. The most common ICW products are:

- ICW treatment plan or course specification
- Storyboards and flowcharts
- ICW lessons
- Supporting materials

Table 14. ICW Phases and Steps

I T E M	A	B	C
	Phase	Step	Description

1	P L A N N I N G	Develop a process outline.	Document development process, staffing requirements, and completion schedule.
2		Develop quality control procedures.	Document quality control process and staffing requirements.
3		Prepare the development team.	Make staff assignments and determine resource and training needs.
4	D E S I G N	Determine course structure.	Segment course objectives into lessons.
5		Define instructional strategies.	Develop basic strategies for multiple lessons.
6		Develop design specifications.	Define lesson components and document format and operation standards.
7		Design data bases.	Determine organization of project data bases (graphics library, CMI, and storyboard).
8		Develop lesson designs.	Develop/sequence subordinate objectives, practice items, feedback, and test items.
9		Develop lesson flowcharts.	Plan/sequence individual lesson displays and make initial graphics/video designs.
10	P R O D U C T I O N	Develop storyboards.	Fully develop text and narration; fully design graphics and video shots.

11	Produce graphics.	Develop graphics for lesson and store in graphics library data base.
12	Initiate lesson programming.	Enter text, graphics, branching logic, etc., from storyboard to create an operational lesson. (Program all nonvideo lesson segments.)
13	Produce visual material for videodisc.	Shoot photographs and video of operational equipment, procedures, etc.; select best frames.
14	Record narration.	Record IVD narration using storyboard scripts.

Continued

Table 14. ICW Phases and Steps (Continued)

I T E M	A	B	C
	Phase	Step	Description
15	P O S T P R O D U C T I O N	Select photographs or video frames.	Review all visual "takes" and select best shot.
16		Edit video.	Perform video editing and create composites.
17		Design videodisc layout.	Plan placement of frames on videodisc to reduce access time during lesson operation.
18		Review master tape or videodisc.	Perform quality control for final approval.
19		Update storyboards.	Enter final frame numbers onto storyboards.
20		Complete lesson programming.	Program video-dependent segments of lesson.

**Define Staff
Position and
Responsibilities**

The make-up of the development team (see Table 9) depends on the characteristics of the proposed ICW and the authoring software selected for the project. As part of your project plan, you need to describe the positions and responsibilities of each ICW team member. Define their individual assignments and how they will work together as a team to produce interim products and final lessons.

**Develop a Master
Schedule**

Develop a master schedule as part of your process outline. Define completion dates for each interim and final ICW product. The ICW development team will use this schedule to pace its efforts. The ICW management team will use this schedule to track progress on the effort.

Section B

Prepare the Project Team

Introduction

Once you have developed the master schedule and you have defined the roles of all project team members, you need to prepare the project team to do the job. Do the following things:

- Determine training requirements.
- Provide documentation.

**Determine
Training
Requirements**

The key to determining team members' training requirements is to examine their experience. Determine the background of the team. If members do not have ICW experience, they are likely to need some training. If they do have ICW experience, they still may need formal training on the software package chosen if they lack experience with it.

**Provide
Documentation**

The development team members will need copies of documents that explain how they are supposed to do their job. They should also receive documents that are required to develop ICW, such as:

- Development process outline
 - Quality control procedures
 - ICW design specifications
 - ICW hardware and software user's manual
-

Section C

Develop Quality Control Procedures

Introduction	<p>The last activity performed during the planning phase is to develop the quality control (QC) procedures to give to the project team members. The QC procedures should be updated throughout the project to ensure that lessons learned in one part of the project are applied to work remaining to be accomplished. Include the following in the QC procedures:</p> <ul style="list-style-type: none">• Establish a review and approval process.• Develop QC job aids.• Establish a process to report discrepancies.
Review and Approval Process	<p>The review and approval process should be established to make sure that all products meet quality standards. Table 15 provides a suggested format for tracking review and approval processes.</p>
How to Use the Review and Approval Form	<p>The review and approval form should be filled out and attached to each product associated with a lesson. As the product is reviewed and approved, the document should be signed by the approving authority. The document should be complete for each product associated with the lesson. The primary author should date the form to tell the reviewer when the review must be completed. The form should not be signed until all suggested corrections are made, checked and approved. Unapproved products should be returned to the author for correction.</p>
QC Team Responsibilities	<p>QC is the collected responsibility of the entire development team, and each member has specific review and approval duties. Table 16 shows the general QC responsibilities for each team member. It also shows the importance of the review and approval sign-off.</p>
QC Job Aids	<p>The review checklist is the primary QC job aid. This checklist outlines each product to be reviewed in conjunction with the personnel responsible for each. A separate checklist should be made for each courseware product. Tables 17 and 18 show sample review checklists. Many items on the checklist are taken directly from the design specification document. Your ICW job aids may use some of the same information.</p>

Table 15. Sample Format for ICW Review and Approval

ALL-PURPOSE CHECKLIST		Page of Pages		
TITLE/SUBJECT/ACTIVITY/FUNCTIONAL AREA		OPR		DATE
ICW Review and Approval				
No.	Item (Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)			
Lesson Name:		S U S P E N S E	I N I T I A L S	D A T E
Primary Author:				
Start Date:				
Final Due Date				
Product	Review/Approval Sequence			
Lesson Design	Courseware Developer			
	Subject Matter Expert			
	Instructional Designer			
	Quality Specialist			
Lesson Flowchart	Courseware Developer			
	Instructional Designer			
Storyboard	Courseware Developer			
	Subject Matter Expert			
	Instructional Designer			
	Quality Specialist			
Programmed ICW Lesson	Courseware Developer			
	Subject Matter Expert			
	Instructional Designer			
	Quality Specialist			
	Project Manager			
Comments:				

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Table 16. QC Responsibilities of ICW Development Team

I T E M	A	B	C
	Position Title	Quality Control Responsibility	Significance of Review and Approval Sign-Off
1	Courseware developer	Authors an easy-to-understand, technically accurate lesson that is consistent with design documents.	Product has been reviewed and is judged to be satisfactory and consistent with design documents.
2	Instructional designer	Reviews lesson products for instructional integrity and conformance with design documents.	Product has been reviewed and is judged to be instructionally effective and consistent with design documents.
3	Subject matter expert	Reviews lesson products for technical accuracy, currency, and completeness.	Product has been reviewed and is judged to be technically accurate, current, and complete.
4	Courseware programmer	Programs lessons according to design documents and storyboard instructions. Develops clear, easy-to-read graphics according to storyboard instructions.	Operational lesson has been reviewed online and is judged to be "bug"-free and to operate as specified. Static graphics are clear; animated graphics operate as specified and correct video and graphics are called into lesson at the correct location.
5	Graphic or computer artist	Develops clear, uncluttered, easy-to-read graphics according to storyboard instructions.	Online graphics have been reviewed and are judged to be correct, clear, and easy to read.
6	Media specialist	Produces high quality, clear videotape according to shot list and storyboard instructions.	Videotape has been reviewed and is judged to be high quality.
7	Quality specialist	Reviews lesson products for instructional integrity and conformance with design documents.	Product has been reviewed and is judged to be instructionally effective and consistent with design documents. Operational lessons are user-friendly and consistent.

Table 17. Sample Format for Subject Matter Expert (SME) Design Review

ALL-PURPOSE CHECKLIST		PAGE OF PAGES		
TITLE/SUBJECT/ACTIVITY/FUNCTIONAL AREA		OPR		DATE
Subject Matter Expert (SME) Design Review				
No.	ITEM (Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)			
Reviewer Name: _____				
Review Date: _____				
Review Item	Comments	Pass	Check List	
Subobjectives related to lesson objectives		1		
Subobjectives sequenced properly		1		
Practice items related to subobjectives		2		
Practice items at proper difficulty level for anticipated students		2		
Practice items provide adequate practice on subobjectives		2		
Practice item feedback identifies correct answer		2		
Critical subobjectives tested		3		
Test items related to subobjectives		3		
Test items at proper difficulty level for anticipated students		3		
Test item feedback identifies correct answer		3		

Table 18. Sample Format for Quality Specialist Final Lesson Review

ALL PURPOSE CHECKLIST		PAGE OF PAGES		
TITLE/SUBJECT/ACTIVITY/FUNCTIONAL AREA		OPR		DATE
Quality Specialist Final Lesson Review				
No.	ITEM (Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)			
Reviewer Name: _____				
Review Date: _____				
Review Item	Comments	Pass	Check List	
Initiating routing commands accesses correct display		1		
Lesson routing conforms with design documents		1		
Text is easy to read and understand		2		
Graphics are clear and easy to read		2		
Video scenes match text		2		
Graphics match text		2		
Animated graphics appear to work properly		3		
Title page displays correct lesson title		3		
Lesson menu is consistent with sections		3		
Section contents match section titles		3		

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How to Use the Review Checklists

Use the review checklists to track the completion of assigned reviews. Have reviewers sign, date, and return the completed checklists to their supervisor. Products judged **adequate** are approved during the review and approval process, and products judged **inadequate** are returned to the primary author for correction.

**Report
Discrepancy
Process**

Discrepancies indicate where products do not meet standards. QC procedures should also provide a means to document discrepancies. Table 19 provides a sample format for recording discrepancies. The form identifies the reviewer, review date, product type, discrepancy report number, lesson name, and discrepancy location. Space is provided to describe the discrepancy and suggest corrective actions, and resolve the discrepancy.

Table 19. Sample Format for Discrepancy Report

ALL-PURPOSE CHECKLIST		PAGE OF PAGES		
TITLE/SUBJECT/ACTIVITY/FUNCTIONAL AREA		OPR	DATE	
Discrepancy Report				
No.	ITEM (Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)			
Reviewer Name: _____ Review Date: _____ Product Type: Design Flowchart Storyboard Lesson DR #: _____ Lesson Name: _____ Location of Discrepancy: Page ____ Paragraph ____ Line ____ Discrepancy Description: _____ _____ _____ _____ Suggested Corrective Action: _____ _____ _____ _____ _____				
Discrepancy Resolution Sign-off		Initials	Date	
Correction Made:				
Correction Verified:				
Discrepancy Closed:				
Discrepancy Remains Open:				
Corrective Action to Close:				
_____ _____ _____ _____				

Chapter 4

HOW TO DESIGN ICW

Overview

Introduction This chapter addresses how to design an ICW course. When you design the ICW, you will use products from the ISD process, such as task analysis reports, lists of learning objectives, and target audience analysis reports.

Where To Read About It This chapter contains four sections:

Section	Title	See Page
A	Develop the ICW Specification	67
B	Determine Instructional Strategies	70
C	Determine CMI and Testing Strategies	84
D	Develop Flowcharts and Storyboards	87

Additional Information For additional information on how to design ICW, see references at the end of each section.

Section A

Develop the ICW Specification

Introduction

The ICW course/lesson specification describes in general terms how the ICW will look and function. This section describes how to develop the ICW specification.

Purpose of Course/Lesson Specification

There are many purposes for the course/lesson specification:

- The ICW design team uses it to guide their efforts in meeting the customer's needs.
 - It serves as a vehicle to get your customer to "buy in" to your ICW efforts. If the customer does not agree with the approach as described in the design specification, you can make changes to the strategy that will not affect work already completed (like storyboards or programmed lessons).
 - The design specification describes what you think is the "best approach" for presenting the ICW instruction.
-

Level of Detail in the ICW Course/Lesson Specification

The most important aspect of the course/lesson specification is the amount of detail it should contain. Keep it short and sweet! If it takes more than 20 pages to describe how the course will look and function at this point, you have not thought things out thoroughly enough. The specification is like an executive summary of the ICW, not a detailed description. Jack Webb said it best: "Just the facts."

Content of the Course/Lesson Specification

The course/lesson specification should include:

- An overview of the content of the course (lesson objectives).
 - A brief description of the instructional strategy. This is a very important aspect of ICW design. Section B describes in detail how to determine the ICW instructional strategies.
 - A high-level description of how the ICW will work from the student's perspective. Take the task data and objectives and determine the number of modules and lessons that will be required to support the objectives. List the modules by name that will make up the course and break the modules into lessons, and give a name to each lesson.
 - Remember, in the ICW design specification you do not need a lot of detail. **You need to provide just enough information to give your developers and your customers a "feel" for the ICW.**
 - A top-level flowchart is a useful way to describe how the ICW will work from the student's point of view. Figure 1 provides a sample of the organization of a typical ICW course.
 - A description of the student measurement (testing) approach for the course.
 - A list of supplemental materials to be developed to support the course.
-

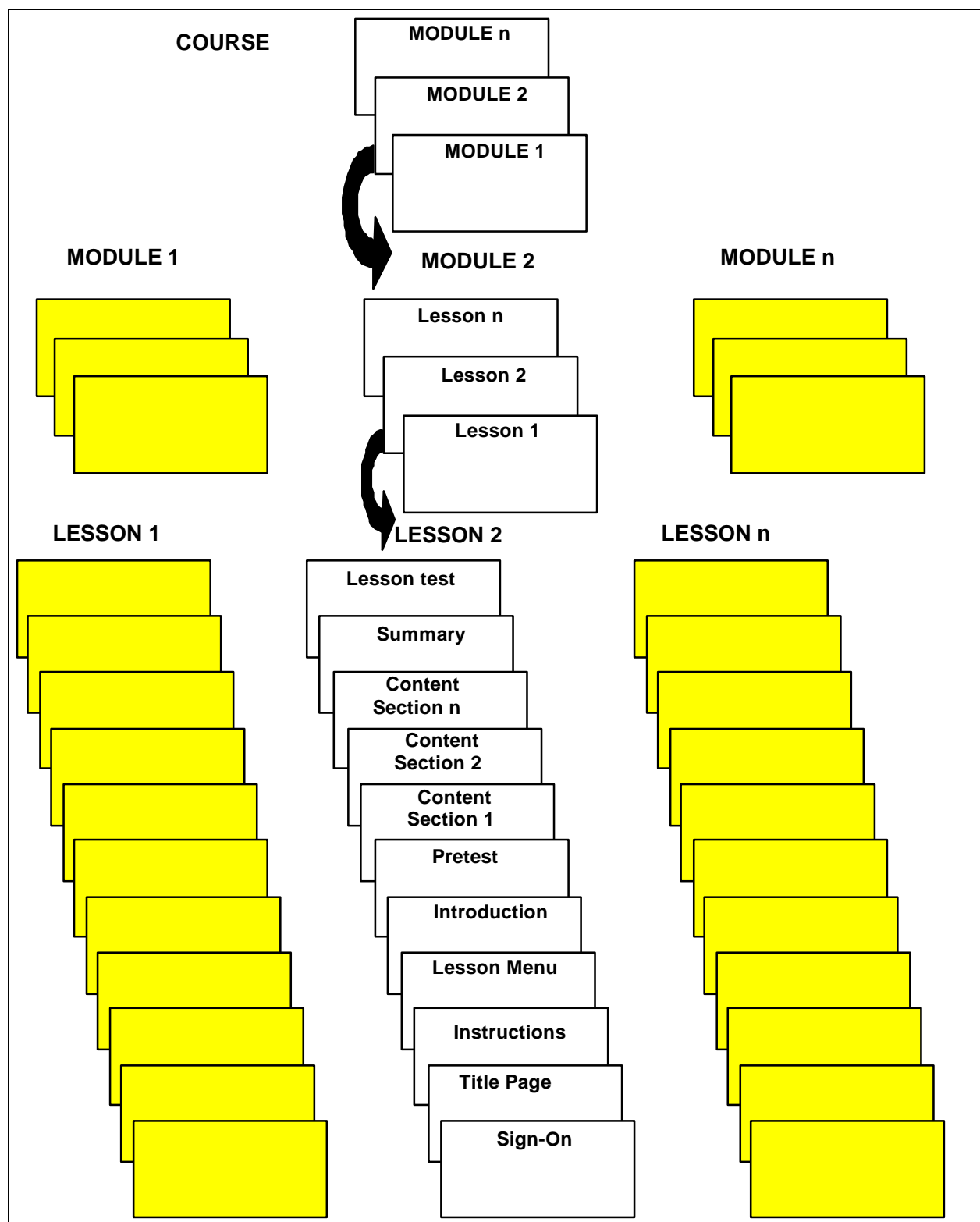


Figure1. Sample ICW Course Organization.

**Additional
Information**

For additional information on developing an ICW specification, see:

- Braden, R. A. (1986). Visual for Interactive Video: Images for a New Technology (with some guidelines). *Educational Technology*, 26(5), 18-22.
 - Griffin, R. E., Miller, S. K., Whiteside, J. A. and Whiteside, M. F. (1985). *Business People, Personal Computers and Graphics Programs Come Together; Visual Literacy Cruising into the Future*. Bloomington, Indiana: Western Sun Printing Co., Inc.
 - Hannafin, M. J. and Hooper, S. (1989). An Integrated Framework for CBI Screen Design and Layout. *Computers in Human Behavior*, 5, 155-165.
 - Jonassen, D. H. (1988). *Instructional Designs for Microcomputer Courseware*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.
 - Miller, R. L. (1990). Ten Good Reasons: Learning Benefits of Interactive Technologies. *The Videodisc Monitor*, February, 15-17.
 - Schwier, R. A. and Misanchuk (1993). *Interactive Multimedia Instruction*. Englewood Cliffs, New Jersey: Educational Technology Publications.
 - Walklin, L. (1982). *Instructional Techniques and Practice. ST(P) Handbooks for Further Education*. Cheltenham, England: Stanley Thornes Ltd.
-

Section B

Determine Instructional Strategies

Introduction

Instructional strategies are the general instructional treatment given to lessons in an ICW course. In determining instructional strategies you will be concerned with ensuring that:

- The ICW design facilitates learning and processing of information.
- The ICW design accommodates the types of information or content of the program.
- Interactivity is increased.
- Degree of learner control is addressed.
- Feedback is appropriate for enhancing learning and transfer.

Each of these issues is addressed below.

Events of Instruction for ICW

Particular activities or events can be designed into ICW programs to help ensure that learning occurs. The method chosen for inclusion in this pamphlet is Gagné's "Events of Instruction." Table 20 lists the events of instruction for ICW and describes the purpose of each. Examples are included for each event.

Types of Content

Content of training programs can be categorized as a particular type of information. The type of information affects the design of lessons in terms of processing required, the instructional treatment used, and requirements for practice within a lesson. Table 21 provides the definitions and examples for five types of content.

Instructional Implications of Content Type

Depending on the type of content, different levels of information processing may be required. Table 22 shows the level of processing required of the learner and suggests appropriate instructional treatment and practice requirements for each content type.

Guidelines for Increasing Interactivity

A key feature of ICW is that it provides the opportunity to involve the learner in a training program. It is important to design as much meaningful interaction as possible into an ICW program.

Table 20. Events of Instruction for ICW*

Events of Instruction		
Event	Purpose	Examples
1. Gain Attention	<ul style="list-style-type: none"> Focus student attention on key information Motivate 	<ul style="list-style-type: none"> Use humor Show consequences of certain actions
2. Inform Student of Objective(s)	<ul style="list-style-type: none"> Tell students what they are about to learn 	<ul style="list-style-type: none"> Tell Demonstrate Ask rhetorical questions
3. Stimulate Recall of Relevant Prior Knowledge	<ul style="list-style-type: none"> Help students retrieve background and prerequisite information 	<ul style="list-style-type: none"> Ask rhetorical questions Present a review Remind students
4. Present Information	<ul style="list-style-type: none"> Teach students the required knowledge/skills 	<ul style="list-style-type: none"> Use audio, text, video, and graphics Compare similarities and differences Point out critical and distinctive features
5. Provide Guidance	<ul style="list-style-type: none"> Enhance comprehension and retention 	<ul style="list-style-type: none"> Ask probing questions Give students hints or options for help Use mnemonics, job aids, checklists
6. Elicit Performance	<ul style="list-style-type: none"> Provide practice 	<ul style="list-style-type: none"> Ask questions Ask students to do something
7. Provide Feedback	<ul style="list-style-type: none"> Address student's misconceptions or lack of knowledge and skills 	<ul style="list-style-type: none"> Feedback can be: <ul style="list-style-type: none"> right or wrong explanation why remediation
8. Assess Performance	<ul style="list-style-type: none"> Determine if students have mastered the objectives 	<ul style="list-style-type: none"> Test on knowledge/ understanding Test on task performance
9. Enhance Retention and Transfer	<ul style="list-style-type: none"> Help students apply knowledge and skills learned 	<ul style="list-style-type: none"> Review questions missed in practice Provide a summary Practice across different situations Practice in real job environment

*Source: Gagné, R. M. (1985). *The Conditions of Learning and the Theory of Instruction* (4th ed.). New York: Holt, Rinehart and Winston.

Table 21. ICW Content Types

Content Type	Definition	Example
Fact	<ul style="list-style-type: none"> • Unique, one-of-a-kind type of information 	<ul style="list-style-type: none"> • Parts of a car
Concept	<ul style="list-style-type: none"> • Class of items that share critical common features 	<ul style="list-style-type: none"> • Cars • Horsepower • Torque
Principle	<ul style="list-style-type: none"> • Cause-and-effect relationship that results in predictable outcomes 	<ul style="list-style-type: none"> • If the engine generates more horsepower, more torque is produced
Procedure	<ul style="list-style-type: none"> • Series of clearly defined steps which result in achievement of a job task 	<ul style="list-style-type: none"> • How to change oil
Process	<ul style="list-style-type: none"> • Description of how things work (i.e., what happens) 	<ul style="list-style-type: none"> • How a car engine works

Table 22. Level of Processing for Content Type

Content Type	Level of Processing	Instructional Treatment	Practice Requirements
Fact	Remember	<ul style="list-style-type: none"> • Provide tutorial • Use lists, charts, or graphics (with labels) to present facts 	<ul style="list-style-type: none"> • Provide drill and practice to reinforce recall • Provide job aid if memorization of the facts is not essential • Provide opportunities to practice facts in context (e.g., in processes or procedures)

Continued

Table 22. Level of Processing for Content Type (Continued)

Content Type	Level of Processing	Instructional Treatment	Practice Requirements
Concept	Application	<ul style="list-style-type: none"> • Provide tutorial • Present definition, examples, non-examples, and analogies of a concept • When presenting examples and non-examples, start with clear-cut ones and then move to fuzzy ones 	<ul style="list-style-type: none"> • Provide drill and practice to reinforce classification • Use new examples and non-examples in practice • Provide opportunities to practice concepts in context (e.g., in principles)
Principle	Application	<ul style="list-style-type: none"> • Present guidelines and examples (and perhaps non-examples) to illustrate a principle • Use graphics, video, or animation • Analogies may help clarify the point 	<ul style="list-style-type: none"> • Provide drill and practice to facilitate automaticity • Provide problem-solving exercises and simulation to reinforce transfer
Procedure	Application	<ul style="list-style-type: none"> • Demonstrate steps and provide follow-along practice • Use flowcharts, action/decision tables, and checklists for mental procedures • Use video for demonstrating physical procedures 	<ul style="list-style-type: none"> • Provide drill and practice to facilitate automaticity • Provide problem-solving exercises and simulation followed by hands-on exercises in real job environment to ensure transfer

Continued

Table 22. Level of Processing for Content Type (Continued)

Content Type	Level of Processing	Instructional Treatment	Practice Requirements
Process	Application	<ul style="list-style-type: none"> • Illustrate the flow of the process • Use graphics, animation, or video to portray a process if real objects are involved (e.g., blood flow in human bodies) • Use process tables or flow diagrams to present a process if it is abstract (e.g., management process) • Analogies may help clarify the point 	<ul style="list-style-type: none"> • Provide drill and practice to enhance retention • Provide problem-solving exercises and simulation to reinforce transfer

Definition of Interactivity

In any type of computer-based training, interactivity refers to the activities performed by both the learner and the computer. The quality of interaction depends on a number of variables, including the type of input required by the learner, how the response is analyzed, and how the computer responds back to the learner. Table 23 presents guidelines for increasing interactivity in ICW training programs.

Guidelines for Learner Control

In many instances learners can make appropriate decisions about the most effective way to proceed through a training program. Research suggests, however, that in many instances, learners do not choose the most effective route; therefore, careful consideration of learner control issues is important in the design of ICW.

Table 23. Guidelines for Increasing Interactivity

#	Guideline Description	Rationale
1	Provide opportunities for interaction at least every three or four screens or, alternatively, about one per minute. However, mandatory interaction with the computer should not be superficial.	Without interaction, the program is just a fancy electronic page turner. However, if an action required is somewhat superficial, the student may be distracted by it and become annoyed. Students prefer not to have superficial interaction.

Continued

Table 23. Guidelines for Increasing Interactivity (Continued)

#	Guideline Description	Rationale
2	Chunk the content into small segments and build in questions (with feedback), periodic reviews, and summaries for each segment.	Chunking content into smaller units and providing opportunities for interaction (e.g., questions) within each information segment allows students to interact with the program more frequently.
3	Ask as many questions as possible without interrupting the continuity of the instructional flow.	Questions: <ul style="list-style-type: none"> • Produce immediate feedback to students regarding their own performance • Provide information for the system to evaluate student performance and take necessary actions • Sustain student attention by keeping them mentally active in the learning process
4	Ask a question after, but not immediately following, the related content.	A gap between a post-question and its related content forces learners to mentally search for and review necessary information, rather than repeating what they were just taught. This searching and reviewing enhances retention.
5	Sometimes a straightforward presentation of new content can be boring. Ask students a question related to the content that hasn't been taught but the answer can be figured out using previously learned knowledge.	This adds variety, challenges students, and maintains their interest.
6	Ask questions at the application rather than the memory level.	Application questions enhance attention and comprehension and facilitate transfer of learning.

Continued

Table 23. Guidelines for Increasing Interactivity (Continued)

	Guideline Description	Rationale
7	Use rhetorical questions during instruction to get students to think about the content or to stimulate their curiosity. Also use them as a natural transition between frames.	A rhetorical question is a question that does not require students to overtly provide an answer. It invites students to <i>mentally</i> interact with the content. Used as a transition aid, it can direct students' attention to what is coming up next.
8	Consider designs where the learner is not presented with information in a linear format, but rather discovers information through active exploration in the program.	This adds variety, challenges students, and maintains their interest.

**Definition of
Learner Control**

Learner control refers to the degree to which learners are allowed to take charge of the aspects of the instruction and their learning environment: what to learn and how to learn it. Table 24 presents some guidelines for designing learner control of content, sequencing, and pace into ICW training programs.

Table 24. Guidelines for Designing Learner Control into ICW

#	Guideline Description	Rationale
Provide learner control over pace when:		
1	Students believe that spending more time on a topic will increase their success.	Students are often more satisfied with a program when they can choose the pace because they can spend more time on the topics that relate to their personal needs and goals.
2	You believe that students will benefit from additional time, (that is, their performance will improve).	Additional time may allow students to integrate new information with previous knowledge.
Provide learner control of sequence when:		
1	Lengthy instructional programs are introduced with no specific presentation order.	Control over sequence will help maintain learner motivation and interest.

Continued

Table 24. Guidelines for Designing Learner Control into ICW (Continued)

#	Guideline Description	Rationale
2	Students are familiar with a topic and are able to make appropriate sequence choices.	Students can choose information which will be relevant to them.
3	The type of learning includes cognitive strategies or higher-order problem solving.	Sequence control will allow students to make selections that may facilitate flexible and novel thinking.
Note:	<p>Do not provide sequence control to students in situations where the materials have a specific prerequisite order.</p> <p>Determine the amount of learner control based on your resource availability as well as these guidelines</p>	<p>Learning could be inhibited if the sequence is improperly chosen.</p> <p>The more control you allow the student over content, pacing, and sequence, the more development work and therefore the more resources will be required.</p>
Provide full learner control of content if:		
1	Students have significant previous knowledge of the content.	Presentation of known materials could be irrelevant and uninteresting to students.
2	Students have higher ability (that is, they are "sophisticated" learners).	Sophisticated learners may be better able to make content choices based on their needs.
3	There is a high probability that students will succeed in learning the content regardless of the chosen content.	Students will perceive through feedback that success is under their personal control and is in fact relatively independent of the chosen content.

Continued

Table 24. Guidelines for Designing Learner Control into ICW (Continued)

#	Guideline Description	Rationale
4	Cognitive strategies and higher-order problem-solving (rather than facts) are being taught.	This guideline supports individual differences in learning style. Different students may see the relevance of different content and will be able to use this information effectively in novel ways during the learning of cognitive strategies and higher-order problem solving.
5	The skills are not critical, the training is optional, and student motivation is high.	This guideline will help to enhance learning for highly motivated students.
Note: Do not provide full learner control of content when all topics in the instructional presentation are required for successful completion of the program or when there is a hierarchical order to the materials.		The student may skip over relevant information.

Influencing Factors

The following factors may influence your decisions regarding the amount of learner control you design into the ICW:

- Your knowledge of the target audience
- Learning skills of the target audience
- Motivation of the target audience
- Type of content
- Criticality of training
- Available resources

Guidelines for Feedback Design

Another important aspect of good ICW design is the use of feedback to the learner.

Definition of Feedback

Feedback refers to the indication that tells the learner about the accuracy of their response. Feedback can be used to address any possible student misconceptions or lack of prerequisite knowledge. Feedback can be used to help students learn, enhance retention and measure how much they have learned. Table 25 presents guidelines for designing feedback for ICW.

**Content of
Feedback**

Feedback may consist of:

- Knowledge of results (correct or incorrect)
- Explanation why the selected response is correct or incorrect
- Branching to remedial session (optional or forced)

Table 25. Guidelines for Designing Feedback for ICW

#	Guideline Description	Rationale
1	Keep feedback on the same screen with the question and student response.	Reduce memory load.
2	Provide feedback immediately following a student response.	Information about test results is an important element in the learning process. Delayed feedback can confuse students.
3	Provide feedback to verify the correctness and explain why.	It may not be clear to students why their responses are correct or incorrect. Therefore, in addition to knowledge of results, feedback should provide specific information about why a response is correct or incorrect.
4	For incorrect responses, give the student a hint and ask the student to try again.	Without the hint, students may fail again and feel frustrated. The hint helps students recall relevant information to answer the question.
5	Tailor the feedback to each learner's response.	Feedback should address the misconception a student may have by selecting a particular incorrect response.
6	Provide positive feedback. However, do not provide the type of feedback that may encourage incorrect responses.	Feedback, when properly used, can provide students with the motivation to learn. Cynical or negative feedback may discourage a student.

Continued

Table 25. Guidelines for Designing Feedback for ICW (Continued)

#	Guideline Description	Rationale
7	In simulation, feedback is embedded in how the simulated world responds to a particular learner action. Add instructional feedback to simulation responses to explain why the simulated world reacted in a certain way or to provide a hint.	Instructional feedback guides the student through the simulation. Later it can be phased out to facilitate transfer.
8	If possible, allow students to print out a copy of their test results.	Often students like to maintain a hard copy record of their performance.

**Additional
Information**

For additional information on determining instructional strategies, see:

Increasing Interactivity

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Section C

Determine CMI and Testing Strategies

Introduction An important aspect of ICW development is test and test items design and the design of computer-managed instruction (CMI) functions and records.

Definition of CMI CMI is the function of the ICW authoring software related to student data collection. CMI generally includes:

- Registration of the student in an ICW course.
 - Point-of-entry for the student to the course, often based on a pretest performance or previously "bookmarked" location. Students should be able to leave a lesson and return to the same point at a later time.
 - Collection of data regarding the student's performance on tests and practice exercises.
 - Determination of student mastery of objectives.
 - Reporting of information to an instructor.
 - Disenrollment of student from the course.
-

CMI Capabilities Prior to designing the CMI for your ICW course, you need to review the authoring software selected to determine the kind of data collection and analysis that is possible. Refer to Decision Aid 3 for a list of CMI capabilities.

Design of ICW Tests Tests are developed to measure a student's knowledge, skill, or attitude on a particular subject.

Types of ICW Tests The types of tests usually developed in ICW courses are pretests and criterion tests.

Pretest	The pretest is used to measure the student's ability to attain each objective and is used after the ICW is operational to determine what instruction the student needs.
Criterion Test	The criterion test is used to measure the student's attainment of the objectives and to measure the effectiveness of the ICW.

Refer to AFMAN 36-2234 for more guidelines on designing and developing tests.

**Tips for ICW
Test Design**

Table 26 provides guidelines for designing ICW tests.

Table 26. Guidelines for Designing ICW Tests

#	Guideline Description	Rationale
1	Use a student's pretest score to branch the student to "need to know" information.	This reduces student boredom by forcing them to learn things they already know.
2	Use the student's pretest score to gauge deficiencies in entry-level or prerequisite skills and knowledge.	The pretest will stimulate recall of relevant prior knowledge (one of the "events of instruction").
3	For pretests, explain that the students are not expected to know all the answers.	This will put students "at ease" with the new instruction.
4	Introduce the test by telling students how many questions they will see and how long it should take them to complete the test.	This will help students gauge how extensive the test is.
5	Let students "back out" of taking a pretest if they know they do not know the content.	Forcing students to take a test when they know they don't know the content can introduce unnecessary stress into a learning situation.
6	Provide good instructions for taking the test, including how to change answers.	This reduces the possibility of students making errors when they actually have mastered the objective.
7	Provide a method for students to review their completed test.	If students responded with a wrong answer and subsequently realize it, they should be able to correct the answer, just as they can in a paper-and-pencil testing situation.
8	Provide feedback to students' answers in the same order that they answered the questions.	This reduces confusion.
9	Design the program so that the computer "works through" a problem with students instead of just giving the correct answer.	This reduces learning time because a student may have a partially correct answer. The computer should identify the point where the student is in error and invite the student to go on from there.

10	If questions are drawn from a "pool of questions," remove correctly answered questions from the pool.	The learning criterion has been achieved and students should not be required to answer these questions again.
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**Additional
Information**

For additional information on determining CMI and testing strategies, see:

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Section D

Develop Flowcharts and Storyboards

Introduction	This section presents guidelines for flowcharts and storyboard development.
ICW Flowcharts	Prior to the development of the ICW storyboard it is helpful to have a flowchart of the content for the program. Storyboards are then created for each item included in the flowchart. The flowchart also serves to provide order for the instructional sequence.
Definition of an ICW Flowchart	ICW flowcharts are developed to show the layout of the entire ICW course. To save time and effort it is recommended that you use a flowcharting software tool, such as the PC-based tool called "Flowcharting 3, Version 1.1" (product of Patton and Patton Software Corporation). This tool allows a user to build a flowchart very quickly because it creates an image file and flowcharting symbols instead of using the more typical line-draw function.
ICW Flowchart Guidelines	<p>An ICW flowchart outlines the flow through the course. Very little detail is presented other than module and lesson names. Listed below are some guidelines for developing an ICW flowchart.</p> <ul style="list-style-type: none">• Keep it simple. It should communicate to a person without ICW experience.• Don't show individual screens on the flowchart.• Represent entire segments of the lesson by a single entry.• Show just enough detail on lesson branching to depict the overall flow.• Don't indicate specific menus, feedback, remediation, or help screens.• Show the suggested sequence of the modules and lessons.
Example of ICW Flowchart	Figure 2 provides an example of an ICW flowchart.

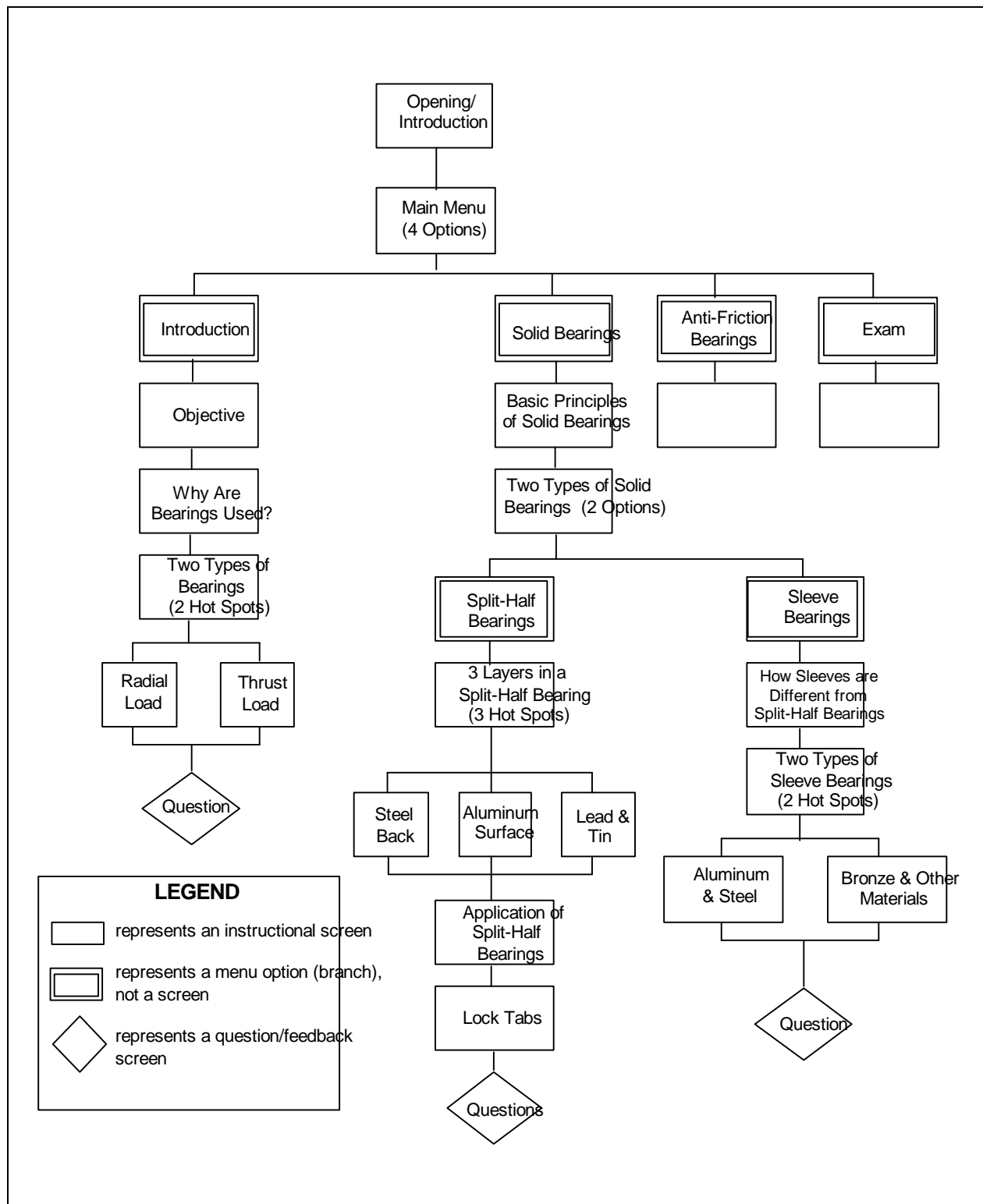


Figure 2. Example of ICW Flowchart (Subject: Bearing Identification).

Definition of Storyboard	Storyboards provide explicit information on how the ICW lessons will look and function. Consideration is given to general principles and visual, audio, and programming elements.
Purpose of Storyboards	Storyboards are used to develop the actual screen presentations for ICW.
Storyboarding Techniques	Storyboards can be developed in print format or automatically using a special purpose storyboarding tool.
General ICW Storyboard Design Principles	<p>There are a number of general ICW design principles which you should consider when developing the ICW storyboards. Examples are:</p> <ul style="list-style-type: none">• User-friendliness• Menu-driven design• Browsing alternatives• Help functions• Record tracking• Navigation• Impact of type of input devices• User messages• Cues• Capabilities of selected authoring software
Guidelines for Implementing the General Storyboarding Principles	Table 27 shows the basic steps involved in storyboard development. Table 28 shows specific guidelines for applying the general storyboard principles and a rationale for implementing each principle.

Table 27. Steps Involved in Storyboard Development

Step	Action
1	Define the scope of the program and collect content. <ul style="list-style-type: none"> • Know your audience. • List objectives. • Identify types of content. • Obtain content. • Verify content. • Identify context of the content (before and after).
2	Agree on program standards (if they do not already exist).
3	Determine program structure and requirements: <ul style="list-style-type: none"> • Menu structure • List of lessons, subjects, and topics included • Navigation options • Available help functions • Program flowchart
4	Determine a high-level instructional treatment for the program.
5	Chunk information into smaller segments.
6	Determine a detailed instructional treatment for each segment (text, video, graphics, animation).
7	Document your designs in a storyboard following the guidelines provided in this reference. <ul style="list-style-type: none"> • Design instruction for each segment. • Design inserted questions, reviews, and summaries for each segment. • Design practice exercises and/or test items (criterion referenced) for larger unit of instruction.
8	Constantly communicate with the production crew to fine-tune your design and to make sure it is implementable.
9	Involve subject matter experts at major milestones in validating the program: <ul style="list-style-type: none"> • Completion of storyboards for one topic • Completion of video segment, graphics, etc. • Completion of a prototype lesson

Table 28. Guidelines for Storyboarding ICW

#	Guideline Description	Rationale
1	<p>Develop a user-friendly system. A user-friendly system should:</p> <ul style="list-style-type: none"> • Be self-explanatory • Make the system functions evident to students • Give students a sense of control • Acknowledge student input (audio or visual) • Be interruptible at any point (e.g., pause and continue, exit program, etc.) • Permit easy reversal of actions 	A user-friendly system prevents students from becoming frustrated with the system and allows them to concentrate on learning the content of the program.
2	<p>Provide a menu-driven system using the following guidelines:</p> <ul style="list-style-type: none"> • Menus should be distinguishable from the rest of the display. • Menus should be consistent in design and display. • Use meaningful labels for menu items. 	Menus display available functions so students do not have to know or remember what's available at any point. They simply select from the range of possibilities offered to them.
3	Provide a browsing alternative.	First-time students can browse through the entire program to get a feel of the content. Students who have gone through the program can use the feature for a quick review or as a reference on the job.
4	If possible, present information on Windows rather than on a separate screen.	Many computer operating systems and software applications use a windows-style user interface to display information. Since windows are portions of the computer screen that have distinct functions from the rest of the screen, they give users a unique view of information and make lessons easier to use.

Continued

Table 28. Guidelines for Storyboarding ICW (Continued)

#	Guideline Description	Rationale
5	Allow the student to request and receive information so that the action to request help does not affect the student's course of action.	Help functions should provide the student with supplemental information, explanations, or assistance without affecting the student's ongoing performance.
6	Clearly identify screen objects.	An object should only be displayed symbolically when its meaning is absolutely clear. If symbols are used, they should convey enough information as to their purpose so that students will not be confused by their function.
7	Provide instructions which describe screen functions.	Learners need appropriate and clear navigational tools and instructions for using the tools to investigate even the most effectively designed programs.
8	Provide student record tracking.	This feature allows student performance records (scores on tests, time spent on a particular task, etc.) in a training program to be collected and analyzed.
9	Provide an <i>optional</i> navigation lesson for new students including: <ul style="list-style-type: none"> • Overview of the content • Special features of the program • Menu structure • How to use a mouse • How to get around in the program 	Students can concentrate on learning the content rather than the navigation mechanism.
10	A mouse is an excellent alternative input device. If a mouse is used, make sure students learn how to use it.	A keyboard is good for text input. A mouse is convenient for: <ul style="list-style-type: none"> • Selecting an object for manipulation • Positioning an object on a display • Making a choice from a menu

Continued

Table 28. Guidelines for Storyboarding ICW (Continued)

#	Guideline Description	Rationale
11	When a mouse is used, make the acceptance area larger than the actual button for faster and easier selection, especially when the button is small. Do not overlap the acceptance area of different targets.	<ul style="list-style-type: none"> Students may click a little off the target and nothing will happen. Overlapping acceptance areas may cause incorrect actions to occur.
12	Provide intermediate feedback when the wait to get a response from the computer is longer than will be comfortable for the student.	Students should never be left wondering if they are supposed to do something or wait for something to happen on the screen.
13	Provide error messages that are informative and low-key. Error messages should: <ul style="list-style-type: none"> Be specific about the nature and the cause of an error Be given immediately after an error occurs Inform students of the correct course of action to take Be non-threatening 	When an error occurs, students should never be left wondering what happened and should be informed as to how they should respond.
14	Provide cues to students at the end of an instructional unit. However, cues may not be appropriate when the students are in a browsing mode or when they have total control over the instructional sequence.	These cues provide a sense of closure and fulfillment, and keep students oriented.
15	Know the capabilities and limitations of your authoring language. Don't design some features that cannot be implemented. Always talk to your programmers.	You don't want to waste time designing ICW which cannot be developed due to limitations of authoring language.

**Guidelines for
Visual Elements**

Visual information in an ICW course serves to enhance the effectiveness of the training program. Visual elements include video, text, graphics and animation.

**Guidelines for
Video**

Table 29 presents general guidelines to consider for visual elements of ICW. The rationale for the guideline is also described.

Video is often a major element of ICW. A high level of detail is necessary in the storyboard to ensure that the video producer has sufficient information to get an accurate video shot. Table 30 presents video guidelines and the rationale for each guideline.

Guidelines for Text

Text may be the primary method for presenting content to the learner or it may serve to highlight certain information. Table 31 presents text guidelines and the rationale for each guideline.

Guidelines for Graphics and Animation

Graphics and animation can be included in an ICW program to enhance learning. Table 32 shows the guidelines for using graphics and animation and the rationale for each guideline.

Guidelines for Audio

Audio is often a major element of an ICW program. The audio part of a storyboard is used by a narrator during audio production. Table 33 presents audio guidelines and the rationale for each guideline.

General Guidelines for Programming

The actual programming or authoring of an ICW program typically occurs in the development phase. However, consideration needs to be given to a number of programming issues during storyboard design.

Programming Standards

It is wise to establish programming standards before you begin to develop the storyboard. Although a certain degree of flexibility is necessary, and changes may occur along the way, standards establish consistency throughout the entire ICW program. Table 34 shows the programming standards you should consider.

Table 29. Guidelines for Visual Elements of Storyboard

#	Guideline Description	Rationale
1	Do not jam a screen with too much information at any one point.	Cluttered screens reduce learning efficiency and effectiveness (i.e., more time to learn and more errors).
2	When presenting a large amount of relevant information, display small chunks of information one at a time through: <ul style="list-style-type: none"> • Screen build-up • Window overlay • Icon buttons 	<ul style="list-style-type: none"> • To reduce memory load. • To facilitate recall and comprehension. • To avoid overwhelming or intimidating students with a large amount of information.

Continued

Table 29. Guidelines for Visual Elements of Storyboard (Continued)

#	Guideline Description	Rationale
3	Use windows to group or separate certain information from the rest of the display.	<ul style="list-style-type: none"> • To draw students' attention to a particular set of data. • To reduce the density of display on the screen by superimposing one display on top of another. • To establish student expectancy that certain data will always appear in a certain format and location.
4	Icon buttons work best for concrete concepts that can be represented pictorially in miniature.	Icon buttons represent information that is available in a compact, easy-to-understand, pictorial format; and upon request of a student, discloses that information.
5	Consider presenting information graphically and spatially (e.g., in a diagram or a flowchart).	<ul style="list-style-type: none"> • Relationships among content or the overall program structure can be more easily visualized and remembered. • A student's path through the program can be easily displayed and remembered.
6	Techniques to keep students oriented: <ul style="list-style-type: none"> • Place certain information in constant locations. • Provide consistent layout for same types of screens. • Maintain a constant perspective in a series of visuals. If a change of perspective is necessary, cue students to the change. • Use letter sizes, colors and shapes as cues. • Provide signposting information about a student's current and past locations, what lies ahead, and how to get there, all available for reference without moving from the current location. • Provide a bird's-eye view or long shot before zooming into details. 	Knowing where they are, how they got there, what they can do, where they can go and how they can get there gives students a sense of control. Making this information available allows students to concentrate on the program content rather than the navigation mechanism. Establishes a frame of reference.

Continued

Table 29. Guidelines for Visual Elements of Storyboard (Continued)

#	Guideline Description	Rationale
7	<p>To position information on a screen:</p> <ul style="list-style-type: none"> • Present key information in prominent areas (e.g., away from the border). • Present information that changes from display to display (the body of the instruction) in the center of the screen. • Present recurrent information (e.g., menu bars) in constant locations. • Present navigation buttons near the borders of the screen. <p>To differentiate key information and attract/direct attention, these cuing techniques are available:</p> <ul style="list-style-type: none"> • Arrows, labels, narration • Display density, white space • Separation of information into distinct objects • Windows • Color, shape • Highlighting, bordering, underlining • Mixed type sizes and fonts • Blinking 	<p>Position information on a screen to establish expectancy and reduce memory load.</p>

Continued

Table 29. Guidelines for Visual Elements of Storyboard (Continued)

#	Guideline Description	Rationale
8	<p>Guidelines for using the cuing techniques:</p> <ul style="list-style-type: none"> • Reserve blinking for critical situations requiring immediate student attention or action. • Borders should be distinct from the object enclosed. • Highlighting can be achieved by either brightening the area of interest or dimming the background. • Limit highlighting to 10% of the display for effectiveness. • Avoid using too many cues at one time. <p>Note: Over-saturation reduces the effectiveness of these techniques.</p>	Helps the student focus on critical elements of the instructional content.
9	<p>Guidelines for using colors:</p> <ul style="list-style-type: none"> • Too many colors on a display reduce effectiveness and aesthetic quality. • Use yellow, green, or white for text. Blue is an excellent background color. But don't use blue for text, edges, narrow lines, or small objects. • Ensure enough contrast between the text color and background color. • Avoid distinctions based on the color cue only. When using colors, always use a second cue (e.g., label, shape, texture) for color-blind students. 	Proper use of colors helps to focus the student's attention to relevant instructional content.

Video Storyboard Guidelines

A video storyboard usually includes sketches of the shots and camera lenses, angles, and movements. Sample standard shot abbreviations are:

CU = Close-up LS = Long Shot
MS = Medium Shot OS = Over-the-shoulder Shot

Table 30. Guidelines for Video Elements of Storyboard

#	Guideline Description	Rationale
1	<p>Tips for preparing video storyboards:</p> <ul style="list-style-type: none"> • Present all information in three-shot sequences (long, medium, and close-up) to establish visual orientation. • Close-up shots grab attention and imply that something is important; long shots establish frames of reference. • A zoom-in focuses attention on a particular object while maintaining visual orientation, providing a similar effect to a three-shot sequence. • A low camera angle looking up at a person implies that the person is strong, powerful, and authoritative. • A high camera angle looking down on a person makes the person appear weak and inferior. • Try to avoid static shots when shooting motion video. • When showing something new, the subject must be focused long enough for the audience to register what is being shown. Once the audience has seen the subject in the shot, you don't have to focus on it as long the next time we show it. • Keep the main subject well lit and watch for possible background distractions. 	<p>Professional conventions for video production.</p> <p>The eye focuses on lighted instead of dark areas and movement instead of static images.</p>

Continued

Table 30. Guidelines for Video Elements of Storyboard (Continued)

#	Guideline Description	Rationale
2	<p>Consider the following motion video formats:</p> <ul style="list-style-type: none"> • Facility/event walk-through (with an off-screen narrator) • Lecture (talking head) • Demonstration (show and tell) • Interview • Talk show • Panel discussion • Dramatization • Simulation • Hybrid format 	Use appropriate format for the content presented and to maintain interest.
3	<p>Two types of simulation:</p> <ul style="list-style-type: none"> • "First-person" simulation - the program creates as closely as possible an actual situation (e.g., operating a piece of equipment or trouble-shooting). • "Third-person" (directed) simulation - the student vicariously experiences some situation by directing a "person" in the program to do whatever the student wants to do. 	The "third-person" simulation may be more appropriate when you want the students to explore the consequences of both right and wrong behaviors in a high-risk situation.
4	<ul style="list-style-type: none"> • Use audio and video to reinforce each other. Never present two unrelated or clashing pieces of information in the two channels. • Design a visual message appropriate to the content. Make sure that each visual ties in directly to the accompanying audio. 	Presenting unrelated or clashing information or a visual which is inappropriate can confuse the student.

Continued

Table 30. Guidelines for Video Elements of Storyboard (Continued)

#	Guideline Description	Rationale
5	Present a series of visuals quickly prior to or at the end of instruction.	<ul style="list-style-type: none"> • Quick visual inserts presented <i>before</i> instruction stimulate recall of prerequisites, serve as an advance organizer, direct attention to key information, and heighten interest. • Quick visual inserts presented <i>after</i> instruction remind the audience of the key information (what's repeated is more important) and enhance retention (what's repeated is remembered better).
6	Provide a quick showing of future events or consequences of unacceptable performance (e.g., disaster caused by human errors) prior to instruction.	<ul style="list-style-type: none"> • To impress the audience with the serious outcomes associated with unacceptable performance. • To motivate the audience to adopt acceptable behaviors or practice.
7	Show the same program content repeatedly in either an identical format or a different perspective to draw attention heighten interest, and enhance retention.	<ul style="list-style-type: none"> • What's repeated is remembered better. • The mere fact that something is repeated implies that it is important.
8	<p>Criteria to determine the use of motion video versus still frame:</p> <ul style="list-style-type: none"> • Use motion video if the content requires motion to clearly depict the point. • Motion video adds motivational value to training. • Use still frames if production resources are limited without compromising instructional effectiveness. • Be aware of the storage limitation of your hardware: motion video takes up more storage space than still frames. 	Motion video can be used to represent reality and help the student achieve a high degree of transfer from training to on-the-job performance. For this reason, motion video is often used to support affective domain objectives and simulations.

Table 31. Guidelines for Text Elements of Storyboard

#	Guideline Description	Rationale
1	Limit amount of text on screen.	It is more difficult and takes longer to read text on a screen than in print. People read text on a computer screen at a rate 28% slower than reading from a book.
2	<ul style="list-style-type: none"> Regular text should be left-justified only. Center headings and titles. Use paging (not scrolling) when presenting large amounts of text. Upper case should be reserved for emphasis and titles only. Do not use hyphenations to break words except for compound words. 	Research data indicates that these guidelines make it easier for students to read and comprehend text.
3	<ul style="list-style-type: none"> Provide generous white space to separate blocks of information. Use headings as content summarizers and navigation aids. Convert sentences containing serial items to lists. Organize complex information into tables to help learners integrate program content. 	Makes information more legible.
4	<p>Use attention-getting techniques:</p> <ul style="list-style-type: none"> Limit highlighting or boldface to 10% of the display. Underlining is best for titles or headings. Use reverse video or blinking with extreme discretion. Use mixed type sizes or fonts to differentiate screen components. Use no more than three attention-getting techniques on a single screen. <p>Note: Over-saturation reduces the effectiveness of these techniques.</p>	Helps to focus the student's attention on key information.

Continued

Table 31. Guidelines for Text Elements of Storyboard (Continued)

#	Guideline Description	Rationale
5	Verify the appropriateness of the colors used for text under simulated presentation conditions.	The clarity of colors used for text will vary depending on such factors as lighting of the room where the ICW stations are and degree of proximity of the students to the machine.

Table 32. Guidelines for Graphics and Animation Elements of Storyboard

#	Guideline Description	Rationale
1	Use graphics or animation when: <ul style="list-style-type: none"> • A realistic presentation (i.e., video) may overwhelm the audience with too much detail. • Conditions or problems to be portrayed occur so infrequently that a video presentation is not possible. 	Graphic or animation presentation can direct audience attention to essential information by highlighting the relevant and omitting the irrelevant.
2	When a graphic is used for the purpose of reducing irrelevant details and highlighting key information, video may be used together with or following the graphic presentation.	Graphics can make a link to the real world and enhance learning transfer.
3	Avoid biases or stereotypes in graphics or animation (gender, ethnic groups, etc.).	Students could find it insulting.
4	Use exaggeration and humor appropriately to heighten student interest and to facilitate recall.	Increases motivation. People often remember exaggerated or humorous information better.

Table 33. Guidelines for Audio

#	Guideline Description	Rationale
1	<p>Guidelines to determine the use of text or audio for primary presentation of the program content:</p> <ul style="list-style-type: none"> • Use text when the message is long, complex, or uses technical or unfamiliar terms. • Use audio when the message is short, simple, requires immediate student response, or when the visual channel is overloaded. • To be most effective, audio and text should complement, not compete with, each other. Audio should not interfere with reading from the text and vice versa. 	<p>Research data indicates that these guidelines make it easier for students to comprehend and process information.</p>
2	<p>Audio should support rather than contradict or interfere with visuals. A long silence may confuse students as to what to do. When the video channel is presenting something crucial, don't let the audio compete for attention.</p>	<p>Research data indicates that these guidelines make it easier for students to comprehend and process information.</p>

Continued

Table 33. Guidelines for Audio (Continued)

#	Guideline Description	Rationale
3	<p>Guidelines for scripting narration:</p> <ul style="list-style-type: none"> • Think visually. • Consider students' language ability, subject matter knowledge, and vocabulary. • Use appropriate style and tone. • Write the script for the ear, not the eye. • Keep the language simple, active, and direct. • Use short sentences. • Watch out for acronyms, technical jargons, and unfamiliar terms. Define them if you have to use them. • Make the transitions from one concept to another clear. • Every piece of narration must have a corresponding visual. • Avoid long pauses in visuals waiting for extended narration to finish. • Select appropriate narrators. • Consider alternating male and female voices to provide variety and to maintain audience attention. • Read the script out loud to yourself and listen to how it sounds. 	<p>These guidelines will make it easier for the narrator or professional talent to record or read the ICW audio.</p>

Continued

Table 33. Guidelines for Audio (Continued)

#	Guideline Description	Rationale
4	<p>Script format for professional talent/narrators:</p> <ul style="list-style-type: none"> • Always have your script typed. • Number all pages in the upper right-hand corner. • Use all caps. • Specify how acronyms should be read. • Spell out all numbers. • Spell difficult words and names phonetically. • Separate each letter in an abbreviation with a hyphen (e.g., I-C-W). • Describe nonverbal cues in parentheses. • Indicate pauses by the word "PAUSE" in parentheses. • Indicate emphases in parentheses if inflection is not obvious. • Double or triple space between lines. • The script should not exceed three inches in length and should use a legible type size. 	<p>These guidelines will make it easier for the narrator or professional talent to record or read the ICW audio.</p>
5	<p>Stick to the message. Tell the students only what is relevant.</p>	<p>Production of irrelevant information is a waste of money and time.</p>
6	<p>Keep the script short and simple. If the message is too long, break it into chunks separated by instructional activities (e.g., quizzes, reviews, hands-on exercises).</p>	<ul style="list-style-type: none"> • Students may get bored if they receive information passively from the program for an extended period of time. • Short audio segments are easier to program.

Continued

Table 33. Guidelines for Audio (Continued)

#	Guideline Description	Rationale
7	Use sound effects as cues: <ul style="list-style-type: none"> • A beep or "oh-oh" to clue students that they've done something incorrectly on the screen (e.g., response formatted incorrectly). • A tune associated with a certain event in the program (e.g., quizzes inserted in the instruction, feedback for incorrect responses). 	Once the link between a sound effect and a specific event is established, the sound effect serves as an efficient navigation aid.
8	Keep production limits in mind (i.e., budget, time, technical capabilities). Allow time for audio rework, which could happen as the development effort proceeds.	Avoid reaching a point in the development effort where you have run out of funds and "aren't quite finished" with the program.
9	Provide students with headphones.	Students in lab environment will not be distracted by the audio from other student stations.

Table 34. Programming Standards Considerations

Consider Standards for:	
Screen Type	<ul style="list-style-type: none"> • Course/lesson/subject title screen • Introduction/overview screen • Instructional screen • Inserted question and feedback screen • Review screen • Summary screen • Practice/exercise screen • Test screen • Help screen

Continued

Table 34. Programming Standards Considerations (Continued)

Consider Standards for:	
Screen Layout	<ul style="list-style-type: none"> • Amount of text • Text placement • Headings • Margins • Text font and size • Captions • Color (text, background, emphasis, borders) • Attention-getting cues • paragraph indentation • Buttons (what - navigation/help/content; format - icon/text) • Menus (structure, labels) • Windows
Questions and Feedback	<ul style="list-style-type: none"> • Presentation of questions (text, audio, graphical, or combination) • Type of student responses required (pointing, selecting, or text entry) • Number of tries allowed • Hint • Type of feedback for each try (knowledge of result, explanation, remediation) • Presentation of feedback (text, audio, graphical, or combination)
Presentation Sequence in Each Segment	<ul style="list-style-type: none"> • Title screen • Opening (motivational video segment) • List of objectives • Main body of instruction with inserted questions and periodic reviews • Summary • Exercise, practice, and test
Miscellaneous	<ul style="list-style-type: none"> • Naming conventions for video segments and files • Transition • Sign-on procedures • Cursor placement on each new screen • Voice - e.g., referring to students as "YOU" and the program as "I" or a third person • Movement instruction (given via audio channel or buttons on the screen)

Guidelines for Programming

Table 35 shows a few specific guidelines for programming considerations during the storyboard development event.

Table 35. Guidelines for Programming Elements of Storyboard

#	Guideline Description	Rationale
1	Prepare a flowchart for the overall flow of the program.	<ul style="list-style-type: none"> • It provides a top-level organizer to guide the development of storyboards. • It conveys the complex instructional flow in an interactive program to the programmer during the development phase.
2	Define the abbreviations to be used in the storyboard and communicate them to all production team members (e.g., GR for graphics, MV for motion video).	Defining abbreviations assures that everybody uses the same abbreviations that are understood by everybody else.
3	Follow the program standards, unless you can offer a convincing argument as to why the standards are not applicable to your design.	<ul style="list-style-type: none"> • Standards save time; they eliminate the need for reinvention and modification. • Standards promote clarity and consistency. • Standards should be periodically reviewed, evaluated, and changed if necessary.

Storyboard Checklist

A checklist is provided in Table 36 for you to use to evaluate and improve the quality of any storyboards developed.

Table 36. Storyboard Checklist

Directions: Place a check in the middle column if the corresponding guideline is included in your program. If a guideline does not apply, indicate so with "N/A" for not applicable. Document with comments where appropriate.

I. OVERALL PRINCIPLES**ö Comments:**

1. Program includes the events of instruction or a rationale for omitting an event.		
2. The instructional treatment is appropriate for the content type.		
3. Practice provided is appropriate for the content type.		
4. Objectives provide complete coverage of content to be taught.		
5. Instruction and test items correlate with objectives.		

II. INFORMATION TO BE INCLUDED IN A STORYBOARD**ö Comments:**

1. Identification information is complete.		
2. Programming notes are complete.		
3. Audio script is complete.		
4. Video information is complete.		
5. Graphic information is complete.		
6. Text information is complete.		

Continued

Table 36. Storyboard Checklist (Continued)**III. INSTRUCTIONAL DESIGN GUIDELINES**

Increasing Interactivity	Ö	Comments:
1. Provides ample opportunities for meaningful interaction.		
2. Content is chunked into small segments; and questions (with feedback), periodic reviews, and summaries are built in.		
3. Numerous questions are included, but do not interrupt the continuity of the instructional flow.		
4. Questions follow the instruction to force students to search for and review necessary information.		
5. Students are asked questions related to content that has been taught, requiring them to use previously learned knowledge to answer them.		
6. Questions are at the application rather than the memory level.		
7. Rhetorical questions are included to get students to think about the content, to stimulate their curiosity, or as a transition between frames.		
8. Opportunity is provided where the learner may discover information through active exploration.		

Learner Control	Ö	Comments:
1. Students are given the appropriate amount of learner control.		
2. Learner control designed can be implemented within available resources.		
3. Students are always given control over the following elements: pacing, support information, navigation, termination.		

Continued

Table 36. Storyboard Checklist (Continued)**III. INSTRUCTIONAL DESIGN GUIDELINES (Continued)**

Feedback Design	Y	Ö Comments:
1. Feedback is on the same screen with the question and student response.		
2. Feedback immediately follows the student response.		
3. Feedback verifies correctness and explains why.		
4. For incorrect responses, students are given a hint and the opportunity to try again.		
5. Feedback addresses student misconceptions or lack of knowledge/skills.		
6. Feedback is positive and does not encourage incorrect responses.		
7. In a simulation, instructional feedback is provided in addition to simulation responses.		

Continued

Table 36. Storyboard Checklist (Continued)**IV. STORYBOARD DEVELOPMENT GUIDELINES**

General Principles		Ö Comments:
1. The program is user-friendly.		
2. The program is menu-driven.		
3. A browsing alternative is provided.		
4. Help functions are provided.		
5. Student record tracking is provided.		
6. An optional lesson on navigation is provided.		
7. A lesson on mouse operation is provided when necessary.		
8. Messages are provided when the wait to get a response is long.		
9. Error messages are informative and low-key.		
10. Cues are provided to indicate completion of an instructional segment.		
11. The authoring language is capable of implementing all features designed.		
12. The program provides clear instructions on how the student is to respond.		

Programming		Ö Comments:
1. Programming acronyms are defined.		
2. Program standards are followed (e.g., screen type, screen layout, questions and feedback, sequence of presentation within subjects).		

Continued

Table 36. Storyboard Checklist (Continued)**IV. STORYBOARD DEVELOPMENT GUIDELINES (Continued)**

Audio		Comments:
1. The script is appropriate for the target audience (language, knowledge, vocabulary).		
2. The style and tone are appropriate for the target audience.		
3. The script is conversational in nature.		
4. The script language is simple, active, and direct.		
5. Sentences are short.		
6. Abbreviations, technical jargon, and unfamiliar terms are avoided or defined if used.		
7. Transitions between concepts are clear.		
8. Every piece of narration has a corresponding shot.		
9. There are no long pauses in a visual waiting for an extended narration to finish.		
10. The audio supports the visual rather than contradicting or interfering.		
11. The script is written in a format suitable for professional talents/narrators.		
12. Sound effects are used as cues.		
13. The script is short and simple.		
14. Information is chunked appropriately.		
15. Only relevant information is included in the script.		
16. Audio designed can be implemented within production limits.		

Continued

Table 36. Storbyoard Checklist (Continued)**IV. STORYBOARD DEVELOPMENT GUIDELINES (Continued)**

Visual: General	Ö	Comments:
1. Screens are not cluttered.		
2. Windows are used to group/separate information on the screen.		
3. Methods are used to orient students in the program (e.g., placement of information, consistency of screen layout).		
4. When appropriate, information is presented graphically.		
5. Small chunks of information are presented one at a time through use of windows, icon buttons, and screen buildup.		
6. Cuing techniques are used to attract/direct student attention (e.g., arrows, labels, color, highlight).		
7. Attention-directing cues are gradually faded to facilitate learning transfer.		
8. Color is used appropriately.		
9. Information is positioned appropriately on the screen (location of key information and menu bar).		

Visual: Video	Ö	Comments:
1. Sketches of shots, camera lenses, angles, and movements are included.		
2. The motion video format used is appropriate for the content (e.g., demonstration, simulation, lecture).		
3. Audio and video reinforce each other.		
4. The visual message (e.g., graphics, animation, still frame, motion video) is appropriate for the content.		

Continued

Table 36. Storyboard Checklist (Continued)**IV. STORYBOARD DEVELOPMENT GUIDELINES (Continued)**

Visual: Video	Ö Comments:
5. Shows content repeatedly in either an identical format or different perspective to draw attention, heighten interest, or to enhance retention.	
6. Program appropriately uses motion video vs. still frame.	

Visual: Text Display	Ö Comments:
1. Text is left-justified (no right justification). Headings and titles are centered.	
2. Paging (not scrolling) is used for large amounts of text.	
3. Upper case is used only for emphasis and titles.	
4. Hyphens are not used except for compound words.	
5. There is plenty of white space separating blocks of information.	
6. Headings are used as content summarizers and navigation aids.	
7. Lists are used for serial items.	
8. Tables are used for presenting and integrating complex information.	
9. Attention-getting techniques are used appropriately (e.g., highlight, bold, underline, color).	
10. Spelling, grammar, and punctuation are correct.	

Continued

Table 36. Storyboard Checklist (Continued)**IV. STORYBOARD DEVELOPMENT GUIDELINES (Continued)**

Visual: Graphics/Animation	Ö	Comments:
1. Use of graphics/animation is appropriate for the content.		
2. When appropriate, video is used following a graphic to enhance learning transfer.		
3. Biases or stereotypes in graphics and animation are avoided.		
4. Exaggeration and humor are used appropriately to heighten student interest and to facilitate recall.		

Additional Information

For additional information on developing flowcharts and storyboards, see:

Guidelines for Video Elements

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Chapter 5

HOW TO DEVELOP ICW

Overview

Introduction

This chapter addresses how to develop and produce an ICW course as specified in the ICW storyboards. When you develop ICW you will be concerned with all production requirements, such as programming, producing video and recording audio, developing graphics and animation sequences, pressing laser discs or digitizing video, and preparing support materials such as student workbooks.

Where To Read About It

This chapter contains four sections.

Section	Title	See Page
A	Program the Lessons	122
B	Produce Visual Displays and Record Audio	125
C	Develop Text, Graphics and Animation	127
D	Develop Supporting Materials and Produce to DoD ICW Requirements	129

Additional Information

For additional information on how to develop and produce ICW, see:

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Section A

Program the Lessons

Introduction

This section presents guidelines on ICW programming. Quality programming is a key element to maintaining the courseware. The guidelines presented here are designed to improve the supportability of ICW lessons and help decrease the amount of time required to program the lessons.

Programming Guidelines

Table 37 lists various programming guidelines, what the guidelines mean, and the rationale for implementing the guidelines.

Table 37. Programming Guidelines During Development Phase of ICW

Guideline	Rationale
1. Develop templates for recurring routines.	Many ICW lessons will follow the same structure and will function in a similar manner. Try to reuse as much code as you can to reduce time. Develop template or shell screens and copy them as needed.
2. Develop object libraries.	Group recurring screen elements (such as graphics which will appear in many lessons) into object libraries for easy reuse and modification to save time.
3. Use "built-in" CMI functions if possible.	Some ICW authoring systems have "built-in" computer-managed instruction (CMI) functions and routines to track data. Use these features to save time.
4. Avoid excess use of CMI capabilities.	If your authoring system does not have built-in CMI features and you have to develop your own routines for record keeping and data analysis, you may find that you are using excessive capabilities. Develop CMI to meet the requirements in the storyboard and tailor back the design if your programming system will not easily support it. The minimum data you should collect is test result data, total score, percent score, and whether the student passed or failed according to the training standards.
5. Standardize the file names for all CMI data.	This allows easy data consolidation and analysis across students and classes.
6. Keep track of the size and storage requirements for CMI files.	This is especially important for floppy-disk-based lessons. If you don't keep track of file sizes, you may run out of room and either lock up the lesson or lose some of the data you need.

Continued

**Table 37. Programming Guidelines
During Development Phase of ICW (Continued)**

Guideline	Rationale
7. Keep good software documentation.	One of the most important and costly aspects of ICW is maintenance. Detailed and accurate program documentation is critical to lesson maintenance. Keep lists of all program variables used and indicate where they are and what they are used for. Follow standard screen-naming conventions. Clearly identify any libraries used and the specific items within the libraries. Establish controls to keep those items from being modified without coordination. Assign a single person to function as librarian. Configuration management is critical to success.
8. Maintain master copies of all program data.	Keep in one package a set of master lesson disks and all lesson specifications.
9. Implement DoD STD 2167A Defense System Software Development, for programs developed outside of an authoring system.	Often, your authoring system will not support a function required for the ICW program and you will have to use an external program. When external programs are used, their structure, documentation and integration become important factors in the usability and support of the courseware. External programs must be well documented within the code itself. DoD STD 2167A outlines both the software development process and the documentation required for DoD software.
10. If programming in an authoring systems internal language, try to program within a screen.	Some authoring systems provide an internal programming language to supplement the basic functions of the authoring tool. If you can program within a screen, you will significantly reduce access times while running the lesson.
11. Ensure the integrity of students' files.	Students' files should be protected so that not just anyone can get access to their records. Files can be easily password-protected with most ICW software programs.

Continued

**Table 37. Programming Guidelines
During Development Phase of ICW (Continued)**

Guideline	Rationale
12. Formatively evaluate the ICW software before implementing the program.	Even though most ICW programmers will take painstaking efforts to ensure the program's flawless execution, bugs can still exist. Programming flaws which cause unintentional directional flows or unanticipated characters to appear can cause a student to think the entire program is poorly designed.

Section B

Produce Visual Displays and Record Audio

Introduction This section presents guidelines for producing all ICW visual displays and recording audio.

Definition of Visual Displays The visual displays include full-motion video, still-frame video or photographs. Each visual display required in the ICW will be described in detail on the storyboard.

Guidelines for Producing Full-Motion Video Using full-motion video in ICW is a very effective way to present information. Motion sequences are often recommended for demonstrating operational procedures. Producing full-motion video can be expensive, especially if professional talent is used, crews need to tape on location, special effects are used, and post-video production (editing) is extensive.

Table 38 presents some guidelines for video production and rationales for implementation.

Table 38. Guidelines for Producing Video

Guidelines	Rationale
1. Ensure that actors follow directives on dress and appearance while in uniform.	USAF policy.
2. Ensure that sets are appropriate to actual work environment.	Enhances realism of ICW.
3. Ensure that actors comply with Occupational Safety and Health (OSHA) directives.	Law.
4. Use consistent camera angles, lighting, and distance to emphasize similarities between objects. For analog IVD, show differences between objects by using the same shot and varying only the item that changes.	Reduces confusion for student and can reduce amount of time required to produce video.
5. If analog IVD is produced, tape and edit "cause and effect" sequences one after the other so they will appear side by side on the videodisc.	Provides a much smoother transition between video scenes, and a quicker response time back to the student.
6. Use the techniques "up from black" at the beginning and "fade to black" at the end of each video sequence.	Allows smooth transitions between scenes and from video to graphics or text.

Continued

Table 38. Guidelines for Producing Video (Continued)

Guidelines	Rationale
7. Provide transition screens when moving from a wide-angle to an extreme close-up and highlight where the next screen will focus.	Helps to reinforce the relationship from wide-angle to close-up view.
8. Use video or graphic window overlays to show extreme close-ups of small objects such as knobs and switches in the context of the wider-angle view.	Allows the student to see things in detail.
9. Store all video for an analog IVD in the LaserVision format.	USAF requirements.
10. If the storyboard is automated, use a laptop computer with the storyboard during video production to immediately enter SMPTE codes for selected shots onto storyboard.	Provides an automated edit-decision list and greatly reduces amount of time needed in post-video production.

Guidelines for Audio Recording

Table 39 provides a few guidelines for audio production.

Table 39. Guidelines for Producing Audio

Guideline	Rationale
1. If analog IVD is being produced, use one sound track for narration and the other for sound effects.	Cost-effective. Narration can be recorded on one track while sound effects are recorded on the other.
2. In some instances, use both tracks to record narration.	Narration can be selectively presented. For example, narration in English can be stored on track 1 and narration in another language can be stored on track 2.
3. When analog audio is used, match the audio with the associated visual.	The visual must be displayed for the same length of time as the audio presentation.
4. Use a professional narrator and recording studio during production.	Greatly increases quality of ICW and reduces costs during production. While there are costs associated with using professional talent, money is often saved because it doesn't take them as long to learn and deliver their lines.

Section C

Develop Text, Graphics and Animation

Introduction This section presents guidelines for text, graphics and animation production.

Guidelines for Text, Graphics, Animation Displays Table 40 lists guidelines for production of text, graphics, and animation displays in an ICW program.

Table 40. Guidelines for Displays in ICW Program

Type of Display	Guidelines	Rationale
Text	<ol style="list-style-type: none"> 1. Follow specifications in storyboard for color and font. 2. If analog IVD is produced, avoid pressing text onto the laser disc. 	<p>Product will be produced to match specification.</p> <p>Hard to make changes.</p>
Graphics	<ol style="list-style-type: none"> 1. Follow sketches or drawings shown in storyboard. 2. Use computer to generate graphics when possible. 3. Identify graphics library code. 4. Program graphics to appear on the screen before text or captions. 	<p>Product will be consistent with specification.</p> <p>Can get better detail and more sophisticated-looking graphic.</p> <p>Other developers can access the graphic for their lessons.</p> <p>Easier for the student to comprehend presentation information.</p>

Continued

Table 40. Guidelines for Displays in ICW Program (Continued)

Type of Display	Guidelines	Rationale
Graphics	<ol style="list-style-type: none"> 5. Program large or complex graphics to appear on the screen in logical sections. Each section should finish drawing before the next begins. 6. Program graphics so that the layer farthest away from the viewer is drawn first and finish with the items that are closest to the viewer. 7. Use an arrow instead of a box or circle to highlight graphic objects. 	<p>Makes it easier for the student to view and understand what is being presented.</p> <p>Makes it easier for the student to view and understand what is being presented.</p> <p>Will help to avoid alignment problems between hardware systems.</p>
Animation	<ol style="list-style-type: none"> 1. If motion is the point of an animation, do not begin the animation until the entire screen appears, then prompt the student to begin the animation. 2. If the result of motion is the focus, draw the object and then begin the animation. After the animation occurs, add labels, captions, text on the screen. 	<p>Supports learner control guidelines.</p> <p>Helps to focus the student's attention on key elements.</p>

Section D

Develop Supporting Materials and Produce to DoD ICW Requirements

Introduction	Instructor and user guides are often developed to support an ICW program. This section explains the purpose of supporting materials, and describes current DoD guidelines which apply to all ICW programs.
Purpose of Supporting Materials	Supporting materials should outline and describe all manual procedures required to load, start and complete the ICW program. The guides should also spell out procedures for managing the ICW program.
DoD Guidelines for ICW	Table 41 presents the DoD guidelines for ICW. These requirements are from DODI 1322.20, Development and Management of ICW for Military Training.

Table 41. Guidelines for Producing to DoD ICW Requirements

1. Use Defense Instructional Technology Information System (DITIS).	<ul style="list-style-type: none"> • Determine if existing programs can be used or modified to satisfy requirements. • Add information about your ICW course topic and structure within 30 days of starting program development. • Add information about the development software used and supporting hardware requirements within 30 days after completing your ICW development. • Update the database if the ICW program is revised or taken out of service.
2. Follow programming requirements.	<ul style="list-style-type: none"> • Arrange free and unlimited (for government purpose) rights to execute and distribute your ICW. You are not allowed to pay royalties or run-time fees for execution or distribution of the courseware. These rights must allow others to operate, distribute or maintain the ICW on the government's behalf.

Continued

Table 41. Guidelines for Producing to DoD ICW Requirements (Continued)

<p>2. Follow programming requirements. (Continued)</p>	<ul style="list-style-type: none"> • Your ICW programs must comply with MIL-STD-1379D. • ICW lessons programmed in a software language, simulation models or unique device drivers must comply with the procedures and requirements of DoD-STD-2167A. This does not apply to programs generated using an authoring system.
<p>3. Adhere to Life Cycle Management Requirements.</p>	<ul style="list-style-type: none"> • Develop a comprehensive logistic support package and documentation for your ICW program. This information will detail the procedures necessary to update, reproduce, and modify the ICW throughout its entire life cycle. • A single office should be assigned the responsibility for life cycle management of your ICW program. That office should keep: <ul style="list-style-type: none"> • A set of reproducible masters of the ICW program and all associated documentation masters. • A circulation copy of the ICW and all materials needed to execute and conduct the training. This material must be available for other government agencies to review to determine if they can use the materials to meet their instructional needs. • The life cycle management office must ensure the availability of tools and libraries, assemblers or compilers, ICW source code and documentation.

Continued

Table 41. Guidelines for Producing to DoD ICW Requirements (Continued)

4. Other Reporting Requirements	<ul style="list-style-type: none">• Submit media selection analysis and training evaluation reports through command channels for placement into the Defense Technical Information data banks within 30 days of completion.• Validate and evaluate all ICW programs using students from target population, including guard and reserve students as appropriate.• Advertise proposed procurement of ICW courseware or hardware and announce contract awards in the Commerce Business Daily (CBD) under "Training Services" or Training Aids and Devices."
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BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

MERRILL A. McPEAK, General, USAF
Chief of Staff

EDWARD A. PARDINI, Colonel, USAF
Director of Information Management

Attachment A - Air Force ISD Documents

AFPD 36-22, Military Training

AFI 36-2201, Developing, Managing, and Conducting Military Training

AFI 36-2301, Professional Military Education

AFMAN 36-2234, Instructional System Development

AFMAN 36-2236, Handbook for Air Force Instructors

AFH 36-2235, Information for Designers of Instructional Systems (11 volumes)

Vol 1, Executive Summary

Vol 2, ISD Automated Tools/What Works

Vol 3, Application to Acquisition

Vol 4, Guide to Training Technologies

Vol 5, Interactive Courseware (ICW) Design, Development and Management Guide

Vol 6, Guide to Needs Assessment

Vol 7, Design Guide for Device-based Aircrew Training

Vol 8, Application to Aircrew Training

Vol 9, Application to Technical Training

Vol 10, Application to Education

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Attachment C - Abbreviations

AFH	-	Air Force Handbook
AFI	-	Air Force Instruction
AFMAN	-	Air Force Manual
CALS	-	Continuous Acquisition Lifecycle Support
CD-ROM	-	Compact Disc-Read Only Memory
CMI	-	Computer-Managed Instruction
DoD	-	Department of Defense
DODI	-	Department of Defense Instruction
ICW	-	Interactive Courseware
ISD	-	Instructional System Development
IVD	-	Interactive Videodisc
QC	-	Quality Control
SME	-	Subject Matter Expert
USAF	-	United States Air Force